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Source-Release Modeling Report for Operable Unit 7-13/14

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March 2006

Idaho Cleanup Project

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ABSTRACT

This report documents work performed to simulate contaminant release from buried waste as part of the Operable Unit 7-13/14 remedial investigation and feasibility study. Numerical simulations were performed with the DUST-MS computer code to predict release of contaminants into the shallow subsurface. Site-specific data on inventory and waste form were used as input to the code. The model outputs were then used as inputs for further fate and transport simulations and ultimately for risk assessment to support the Operable Unit 7-13/14 remedial investigation and feasibility study.

The effort documented in this report represents the most comprehensive source-release modeling effort performed at the Idaho National Laboratory Site. The model includes time-dependent disposal, variable infiltration, and accounting for different disposal containers and different release mechanisms for a suite of contaminants, including radionuclides and inorganic and organic compounds. Even a single-release mechanism, such as corrosion of activated metal, could have multiple release rates based on type of base metal disposed.

This model builds on previous work. Enhancements from previous work include increasing the spatial resolution defined by the number of source areas modeled to provide sufficient detail for the evaluation of feasibility study alternatives. The use of the Waste Information and Location Database not only included using the most comprehensive inventory for the Subsurface Disposal Area, but it also defined where contaminants were buried and is a major advancement in the ability to target any potential future remedial action. Additional waste forms, such as fuel test specimens, Vycor[a] glass, and resins, were explicitly accounted for in this model. In addition, the non-time-critical removal actions for the Accelerated Retrieval Project and for grouting of beryllium blocks were modeled.

Sensitivity cases were run to assess the impact of uncertainty on key parameters. Uncertainty cases examine inventory uncertainty by simulating upper-bound inventory, effectiveness of grouting, and the Accelerated Retrieval Project retrieval and by examining the risk if the remedy fails (grout) or does not occur (Accelerated Retrieval Project), and the effect of the infiltration rate by examining the risk for high- and low-infiltration rate cases.

a. References herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government, any agency thereof, or any company affiliated with the Idaho National Laboratory.

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ACRONYMS

ABRA	Ancillary Basis for Risk Analysis
DOE	U.S. Department of Energy
INL	Idaho National Laboratory
IRA	Interim Risk Assessment
LLW	low-level waste
OU	operable unit
PSRA	Preliminary Scoping Risk Assessment
RI/BRA	remedial investigation and baseline risk assessment
RI/FS	remedial investigation and feasibility study
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
VOC	volatile organic compound
WILD	Waste Inventory and Location Database

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1. INTRODUCTION

This report documents the latest in a series of numerical simulations developed to estimate the release of contaminants into the shallow subsurface from waste buried at the Subsurface Disposal Area (SDA). This work supports the remedial investigation and feasibility study (RI/FS) for Operable Unit (OU) 7-13/14; however, only the remedial investigation modeling is covered at this time. This report will be expanded to include feasibility study modeling at a later date. Operable Unit 7-13/14 is the comprehensive evaluation of the Radioactive Waste Management Complex (RWMC) under the Federal Facility Agreement and Consent Order (DOE-ID 1991). The source term for these simulations is defined as the waste buried in the SDA.

Conceptually, the source-term model is simple. Waste was buried either without a container or in containers such as drums, boxes, and bags. Contaminants not in a container are available for immediate release. When the containers fail, the remaining contaminants can be released over time by one of three release mechanisms: surface wash, diffusion, or dissolution. The type of release mechanism and the release rates depend on characteristics of the waste. Mass released from buried waste is available for transport to the subsurface by infiltration or to the surface by biotic uptake.

1.1 Subsurface Disposal Area Overview

The Idaho National Laboratory (INL) Site is located in southeastern Idaho and occupies 2,305 km^2 (890 mi^2) in the northeastern region of the Snake River Plain. Regionally, the INL Site is nearest to the cities of Idaho Falls and Pocatello and to U.S. Interstate Highways I-15 and I-86. The INL Site extends nearly 63 km (39 mi) from north to south, is about 58 km (36 mi) wide at its broadest southern portion, and occupies parts of five southeastern Idaho counties. Public highways (i.e., U.S. 20 and 26 and Idaho 22, 28, and 33) within the INL Site boundary and the Experimental Breeder Reactor I, which is a national historic landmark, are accessible without restriction. Otherwise, access to the INL Site is controlled. Neighboring lands are used primarily for farming or grazing, or are in the public domain (e.g., national forests and state-owned land). Various programs at the INL Site are conducted under supervision of two U.S. Department of Energy (DOE) offices: the DOE Idaho Operations Office and the Pittsburgh Naval Reactors Office. With overall responsibility for the INL Site, the DOE Idaho Operations Office selects and authorizes government contractors to operate at the INL Site. The INL Site provides a variety of programmatic and support services related to nuclear reactor design and development, nonnuclear energy development, materials testing and evaluation, operational safety, radioactive waste management, and environmental restoration. Spent nuclear fuel management, hazardous and mixed waste management and minimization, cultural resources preservation, environmental engineering, protection, and remediation, and long-term stewardship are challenges addressed by current INL Site activities. The laboratory’s future mission, delivering science-based solutions to current challenges of DOE, other federal agencies, and industrial clients, encompasses three areas: energy resources, national security, and science.

The RWMC, located in the southwestern quadrant of the INL Site, encompasses a total of 72 ha (177 acres) and is divided into three separate areas by function: the SDA, the Transuranic Storage Area, and the administration and operations area (see Figure 1-1). The original landfill, established in 1952, covered 5.2 ha (13 acres) and was used for shallow land disposal of solid radioactive waste. In 1958, the landfill was expanded to 35.6 ha (88 acres). Relocating the security fence in 1988 to outside the dike surrounding the landfill established the current size of the SDA as 39 ha (97 acres). The Transuranic Storage Area was added to RWMC in 1970. Located adjacent to the eastern side of the SDA, the Transuranic Storage Area encompasses 23 ha (58 acres) and is used to store, prepare, and ship retrievable transuranic waste to the Waste Isolation Pilot Plant. The 9-ha (22-acre) administration and operations area at RWMC includes administrative offices, maintenance buildings, equipment storage, and miscellaneous support facilities.

Waste acceptance criteria and recordkeeping protocols for the SDA have changed over time in keeping with waste management technology and legal requirements. Today's requirements are much more stringent as a consequence of knowledge developed over the past several decades about potential environmental impacts of waste management techniques. In the past, however, shallow landfill disposal of radioactive and hazardous waste was the technology of choice. At the SDA, transuranic and mixed waste, mostly from the Rocky Flats Plant in Colorado, were buried through 1970. Mixed waste containing hazardous chemical and radioactive contaminants was accepted through 1983. Since 1984, waste disposals in the SDA have been limited to low-level radioactive waste from INL Site waste generators.

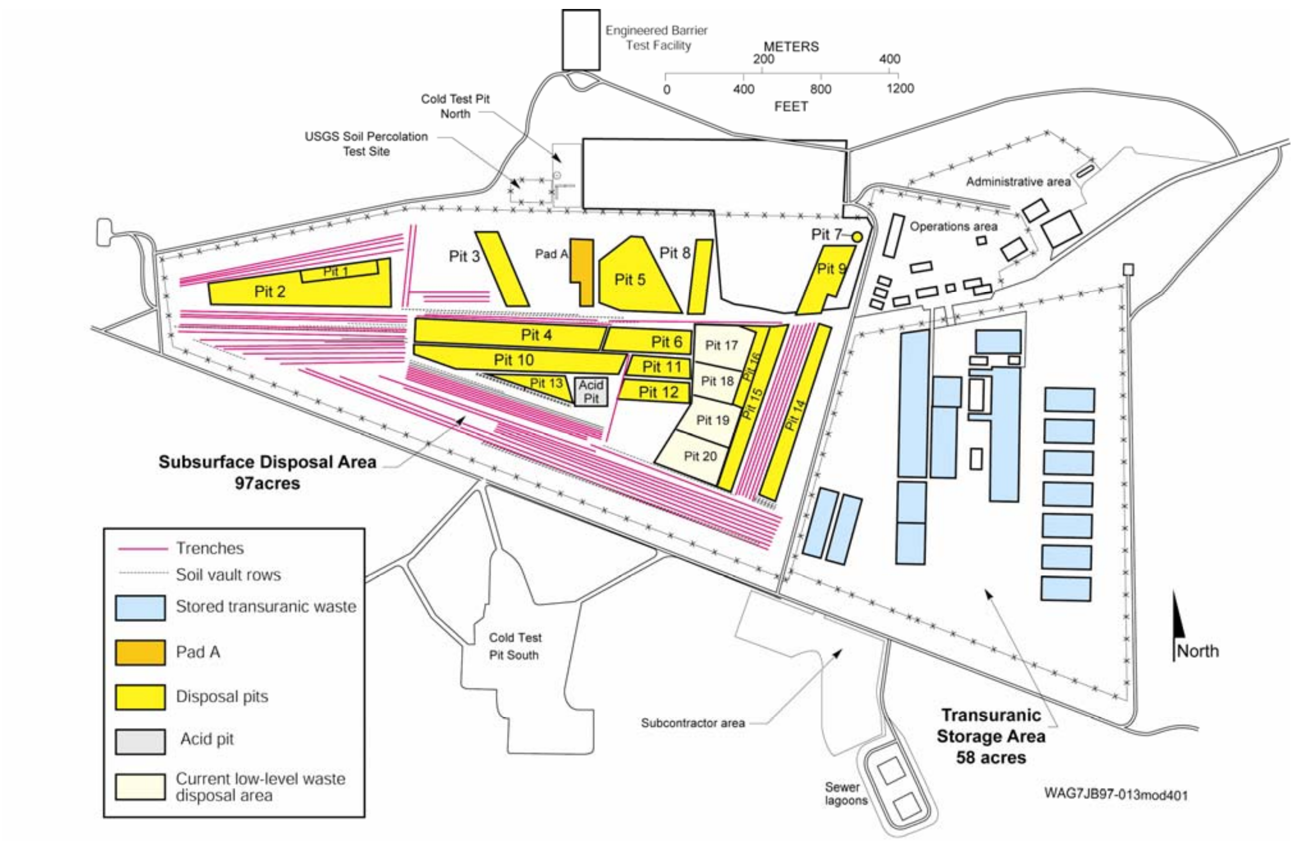


Figure 1-1. Radioactive Waste Management Complex.

1.2 Previous Risk Assessments

Numerous risk assessments have been performed to determine the contaminants of concern for OU 7-13/14. Source-release modeling complexity has increased as risk assessments have progressed from simple screening of contaminants to the current modeling performed for the RI/FS. This section provides a history of previous risk assessments and source-release modeling performed to support the analyses.

1.2.1 Preliminary Scoping Risk Assessment

The Preliminary Scoping Risk Assessment (PSRA) and Revised PSRA (Loehr et al. 1994 and Burns et al. 1994, respectively) were the first attempts to consider the full suite of contaminants in the SDA. It was completed immediately following the Historical Data Task inventory evaluation (INEL 1994). Parts of the inventory were re-evaluated when it was updated (INEL 1995a). At that time, waste in the active Low-Level Waste (LLW) Pit was treated separately from historical buried waste in the rest of the SDA. Therefore, the inventory only included disposals from 1952 through 1983. The PSRA was intended to help scope potential hazards posed by the buried waste and to help support planning for the remedial investigation. Trenches 1 through 58, Pits 1 through 16, Soil Vault Rows 1 through 13, and the Acid Pit were included in this analysis. The inventory on Pad A, Soil Vault Rows 14 through 21, and in Pits 17 through 20 was not.

The PSRA was the first use of a separate source-release model in a risk assessment at the INL Site. Previous risk assessments had been screening assessments that assumed that the contaminant inventory was immediately available for transport. DUST-MS (Sullivan 1993) was used to simulate the release of contaminants from the waste to the subsurface. The output from DUST-MS was the input to the groundwater transport and biotic transport models.

A simplified model of the SDA was used in the contaminant-release simulations. The waste was modeled as a single large pit equal in volume to the disposal areas included previously. The disposal area was modeled as a rectangular area 647 × 181 m (2,122 × 594 ft) (Figure 1-2). The waste was assumed to be homogeneous across the area, and a constant infiltration rate of 10 cm/yr (4 in./yr) was simulated for the entire rectangle.

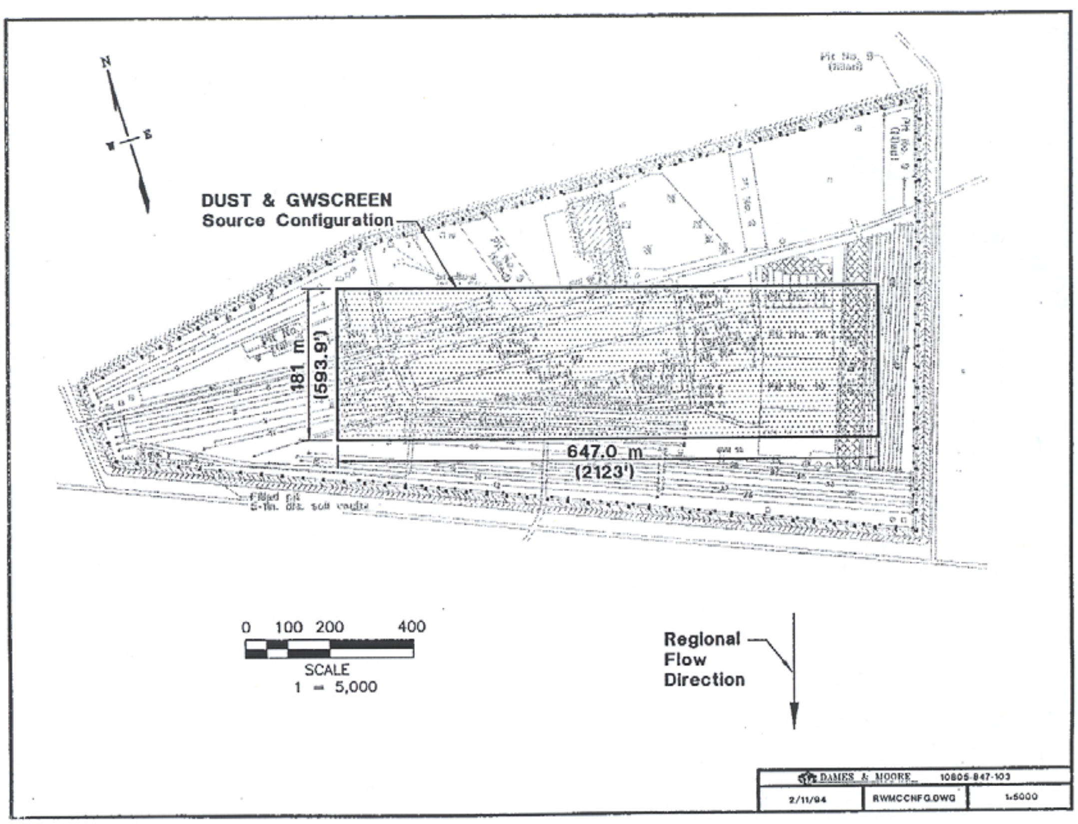


Figure 1-2. The simulated source area used in the preliminary scoping risk assessment.

The PSRA conceptual model for the source release is relatively simple. Waste is disposed of in containers. Once the containers fail, the contaminants are available for release. No credit is taken for any container except metal containers. All metal containers are treated as if they are steel drums. The steel drum model in Walton et al. (1989) was used to simulate the container failure. This model is an exponential decay model and is a conservative estimate of the failure of the metal containers in that it underestimates the time to failure.

The release from the waste was simulated using a combination of the three release models in DUST-MS. The three models were surface wash (with or without solubility limits), dissolution, and diffusion. Surface wash was used for waste that had external contamination on its surface that could be washed. The model was an equilibrium partitioning model, and a partitioning coefficient was used to specify how the contaminant sorbed to the waste. A typical waste form would be personal protective equipment and rags from cleanup of a glovebox. Dissolution was used to simulate the release of contaminants that were an integral part of the waste. A typical waste form would be activated metal where the activation product is not released to the subsurface until the metal corrodes. The diffusion model was not used for the PSRA. It would be used for a waste such as volatile organic compounds (VOCs) diffusing out of sludge. The inventory was developed from disposals from each facility. Disposals of a similar type (e.g., combustible waste from the Advanced Test Reactor) were grouped together as a waste stream. All the waste had a similar waste form, and the release would be similar for all the shipments. For each waste stream that contributed greater than 1% of the total inventory for a contaminant, one of the three DUST-MS release mechanisms was assigned and contaminant-specific release parameters developed.

For the PSRA, the total radioactive waste inventory was decayed to 1994 and the simulations started from that point in time. The complete list of chemical and radiological contaminants listed in the Historical Data Task (INEL 1995a) was modeled, except VOCs, which were not simulated. The results showed that long-lived fission and activation products and some of the uranium isotopes could pose a risk for the SDA. The monitoring program was modified to look for these contaminants in the hope that future models could be calibrated to measured concentrations.

The PSRA was to be used to screen contaminants from further consideration. However, because the inventory was decayed before the start of the simulation, short half-life isotopes that could pose an unacceptable risk were screened. Therefore, the contaminants were rescreened in the OU 7-13/14 Work Plan (Becker et al. 1996).

1.2.2 Screening in the Operable Unit 7-13/14 Work Plan

The Historical Data Task and Recent Projected Data Task (INEL 1995a; INEL 1995b) identified over 300 chemical and radiological contaminants buried in the SDA. The Work Plan for OU 7-13/14 (Becker et al. 1996) screened that list down to 38 radioisotopes and 15 chemicals that were evaluated quantitatively in the next risk assessment. No separate source-release model was used in the screening. The entire inventory was assumed to be available and used in conservative calculations to eliminate those contaminants that pose no risk to human health or the environment.

1.2.3 Interim Risk Assessment

The Interim Risk Assessment (IRA) (Becker et al. 1998) was originally developed to be the comprehensive remedial investigation for OU 7-13/14. Issues with data to be gathered from the Pit 9 remedial action caused the schedule to be extended. The IRA was used to document the work that had been completed and to further screen contaminants of potential concern for OU 7-13/14.

As part of the development of the models used in the IRA, an extensive model selection effort was undertaken for all of the models used in the risk assessment. The process used and the results of the source-term model selection task were documented in Becker (1997) and are summarized in Section 2.1. DUST-MS was selected for source-release modeling in the IRA.

The basic IRA conceptual model used for release of contaminants into the subsurface was similar to that used in the PSRA. That is, waste was buried in containers. When the containers failed, the contaminants were available for release. The actual release rate depended on the waste form and contaminant being released. For each waste stream that contributed greater than 1% of the total inventory for a contaminant, one of the three DUST-MS release mechanisms was assigned. The three release mechanisms were surface wash, dissolution and diffusion. Calibration attempts were based on best-estimate inventory; risk assessment was based on upper-bound inventory.

Major changes and improvements from the PSRA model include:

- **Used the full inventory from 1952 through 1993.** Previously the waste in the active LLW Pits was excluded from the OU 7-13/14 analysis. Since the LLW Pits are collocated with historical disposals, the full inventory was included in the IRA (Becker et al. 1998) years before the Defense Nuclear Facility Safety Board Recommendation (94-2) that all DOE sites do so (DOE G 435.1-1). This allowed assessing the full impact to human health and the environment for contaminants released at RWMC.

- **Based drum-failure rate on retrieval data.** Data on drum failure were reviewed. It was determined that the Walton et al. (1989) model used in the IRA was not representative of the drum failure during the retrievals that had been performed in the SDA. The data supported two distinct drum populations: those that were stacked and those that were dumped. A Gaussian distribution better fit the data than the exponential distribution previously used. DUST-MS did not allow a Gaussian failure distribution; therefore, a manual work-around was performed to simulate drum failure. Multiple simulations were performed, one for each year of the failure distribution curve, to allow for the fraction of drums to be failed in a given year to fail and start releasing its contents. The side effect of this methodology was that solubility limits could not be imposed on the release as individual year simulations were summed to provide a single release file for input into the transport simulations.

- **Modified the C-14 inventory.** The activation product inventory in the Historical Data Task was inconsistent between some of the on-INL generators. As part of the efforts for the LLW Performance Assessment, the inventory for C-14 was modified to try to more completely identify all sources of C-14. The Performance Assessment focused on C-14 because previous work (Burns et al. 1994; Burns, Becker, and Jones 1994; and Maheras et al. 1997) had shown it to be a major contributor to the total risk or dose. The IRA used the inventory improvements, available at the time, for C-14.

- **Improved partitioning coefficients for actinides.** Because of the uncertainty in mobility of many of the actinides, studies were performed at Clemson University to determine the mobility in soil from the INL Site (Grossman et al. 2001). The results of these studies were also used in the source-release modeling.

- **Divided the source into three regions.** The SDA was divided into three regions based on time period and waste acceptance criteria used. Before 1970, transuranic, mixed, and other radioactive waste was buried in the SDA. After 1970, transuranic waste was no longer buried but placed in retrievable storage units at the Transuranic Storage Area. Mixed waste was no longer accepted after 1983. Disposals from 1984 and after must meet LLW disposal requirements. Figure 1-3 shows the three source areas used and how the mass was then input into the vadose zone model (TETRAD).

- **Accounted for yearly disposals.** For contaminants that are highly mobile or those having a short half-life, the rate of disposal can be important in the ultimate risk calculated. The PSRA decayed the total inventory and started the simulations from the current date. This ignored the releases that had occurred since the start of disposal operations and, therefore, would underestimate the risk and mass already released into the vadose zone. Similarly for VOCs, assuming all the mass was buried in a single year would overpredict the releases and overpredict the risk. Therefore, the inventory in each year was evaluated for waste type and assigned the appropriate release mechanisms and drum-failure rates for the simulations.

- **Improved corrosion rate information.** Large fractions of the mobile activation product inventory consist of activated metal. The rate of release depends on the rate of corrosion of the base metal. Studies were performed to better determine a corrosion rate appropriate for SDA soil conditions.

- **Attempted to correlate measured concentrations to simulated concentrations.** The IRA examined measured concentrations in the waste zone and attempted to correlate these to the modeled concentrations. However, many of the measurements were in areas where some of the contaminants were not buried in quantity. Therefore, the correlation is qualitative at best. Even with the qualitative nature of the comparison, some issues were identified.

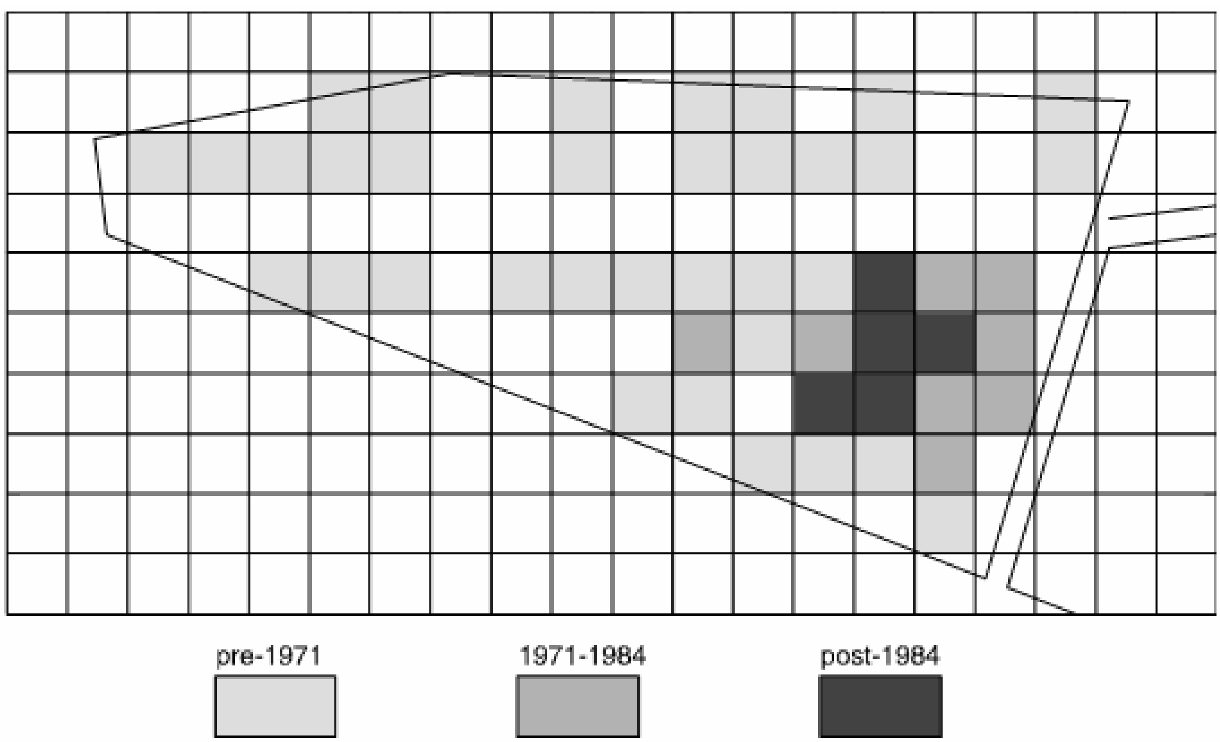


Figure 1-3. Interim Risk Assessment source-term model.

Calibration attempts for the IRA were based on best-estimate inventories, while the risk presented in both the IRA and PSRA were based on upper bounds. Full details of the IRA simulation results are in Becker et al. (1998). A summary of the results follows:

- The inventory of carbon tetrachloride was not adequate to produce the measured plume. As a result, the inventory was revised upward by a factor of 7 from the original value in the Historical Data Task (Miller and Varvel 2005).

- The mobility of chromium was incorrect. The wrong chemical form was assumed when assigning mobility to the waste form. The majority of the chromium disposed of was in a highly mobile chromate salt form, but a less mobile form was initially assumed. Using the more mobile chromate form improved the correlation between the model results and the measured values in the aquifer.

- Not accounting for the vapor-phase diffusion of tritium caused the models to overpredict the measured concentrations in the aquifer by several orders of magnitude. Similar to the VOCs, a large fraction of the tritium will diffuse through the ground surface because the gradient is much higher upward than downward. This reduces the ultimate impact to the aquifer.

- Mobile fission and activation products, carbon tetrachloride, and uranium drove the risk. Further inventory refinements focused on these contaminants. The monitoring was also modified to consider these contaminants as the priority.

1.2.4 Ancillary Basis for Risk Analysis

The Ancillary Basis for Risk Analysis (ABRA) and the Preliminary Evaluation of Remedial Alternatives were originally developed to be the comprehensive RI/FS for Waste Area Group 7. As part of the dispute resolution for Pit 9 (OU 7-10), the schedule was changed, and the RI/FS was delayed nearly 5 years (DOE 2002). To document the completed work, the draft remedial investigation was modified and published as the ABRA, and the draft feasibility study was modified and published as the Preliminary Evaluation of Remedial Alternatives. Figure 1-4 shows the source areas used in the ABRA.

Changes and improvements to the source-release model since the IRA included:

- **VOCs not simulated.** When the ABRA modeling was started, the Organic Contamination in the Vadose Zone Project (OU 7-08) was in the middle of model calibration to calculate remedial goals. As part of that effort, the probing data were evaluated to see if the mass of VOCs remaining in the source could be determined. The remaining source mass has large implications for Organic Contamination in the Vadose Zone Project operations and long-term groundwater risk. It was determined that performing the simulations with the uncalibrated model would not provide useful results. Therefore, the results from the IRA were scaled by the ratio of the new to old inventory. This was conservative, and the calibrated results would be presented in the RI/FS.

- **Corrected inventory for on-INL Site generators.** The LLW Performance Assessment work on the inventory used in the IRA showed a consistent evaluation of fission and activation products from the on-INL Site waste generators was needed. This work was undertaken, and the results completed at the time were incorporated into the IRA. Because not all of the reevaluation was complete when the simulations started, the on-INL Site waste was lumped into an “INEEL reactor operations” waste stream.

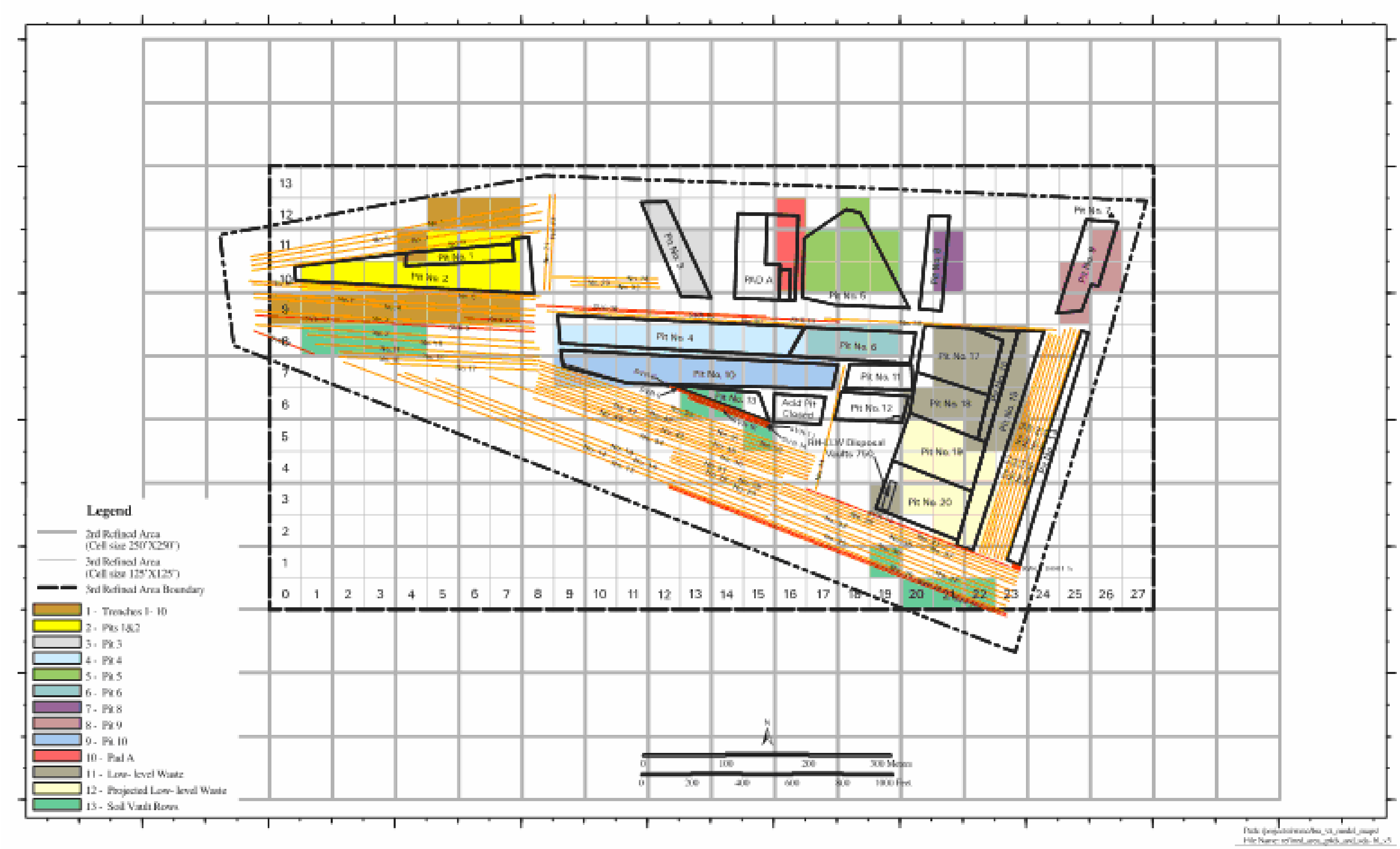


Figure 1-4. Source-release model for the Ancillary Basis for Risk Analysis.

- **Improved source area definition.** The IRA divided the disposal information into three large categories based on waste acceptance criteria. While this was adequate for assessing baseline risk to human health and the environment, it would have been difficult to evaluate the effectiveness of remedial alternatives. Therefore, the source model was further refined into 13 source areas. These source areas correspond to the pit areas with lumped areas for trenches and soil vaults.

- **Better corrosion rate information.** Through a cooperative effort between INL Environmental Restoration and Waste Management programs, site-specific corrosion rates for stainless steel and beryllium were developed based on corrosion tests performed just north of the SDA. The test results were modified to account for the Mg-Cl dust suppressant that was applied to the roads in the SDA in the 1980s. Chloride is highly corrosive and would increase the corrosion rate of metal that it contacts.

- **DUST-MS modified to simulate Gaussian drum failure.** The limitations identified in the IRA modeling for drum failure were corrected by contracting with the author of DUST-MS and including a Gaussian drum-failure model in DUST-MS. This allowed simulating drum failure with solubility limited release.

The results of the ABRA indicated the following:

- Further inventory refinements, for the on-INL Site waste generators, were warranted. The inventory evaluation that started with the ABRA needed to be completed.

- Mobile fission and activation products drive groundwater risk, and better definition of the source areas for on-INL Site generators was needed to support evaluation of remedial alternatives. The source areas for the ABRA had sufficient detail for the pits that contained the Rocky Flats Plant transuranic waste but lacked sufficient detail in the trenches and soil vaults.

- Monitoring data gathered from within the waste zone showed that the release of uranium is limited by the solubility. The sensitivity case presented in Section 6 of the ABRA using the solubility-limit should significantly impact the uranium groundwater ingestion risk.

1.2.5 Peer Reviews of Previous Modeling

The modeling to support the source-release simulations has been peer reviewed by independent reviewers. The reviewers and their findings follow.

The United States Geological Survey was asked by DOE in 1997 to review the modeling for the IRA. A near-final draft of the United States Geological Survey review was made available to OU 7-13/14 in 1998, and several recommendations were adopted in subsequent work for the ABRA and Remedial Investigation and Baseline Risk Assessment (RI/BRA). Their report was published in 2005 (Rousseau et al. 2005). Their review noted the importance of the source-release model in the overall simulation results but focused on the vadose zone and aquifer simulations.

The same modeling used to support the OU 7-13/14 evaluation was also used to support the Performance Assessment and Composite Analysis performed as part of operating the LLW facility at the SDA. The IRA supported the Performance Assessment/Composite Analysis revision in 2001 (McCarthy, Seitz, and Ritter 2001). The Composite Analysis used the full inventory simulations, and the Performance Assessment used the simulations for the waste buried from 1984 and after. The review identified concerns about some of the release parameters but found no issue with the use of the model. Specifically, the corrosion release rate parameters were not the standard used in many performance assessments; therefore, further work to justify the site-specific values was recommended. The corrosion studies performed to date are partially a result of this recommendation.

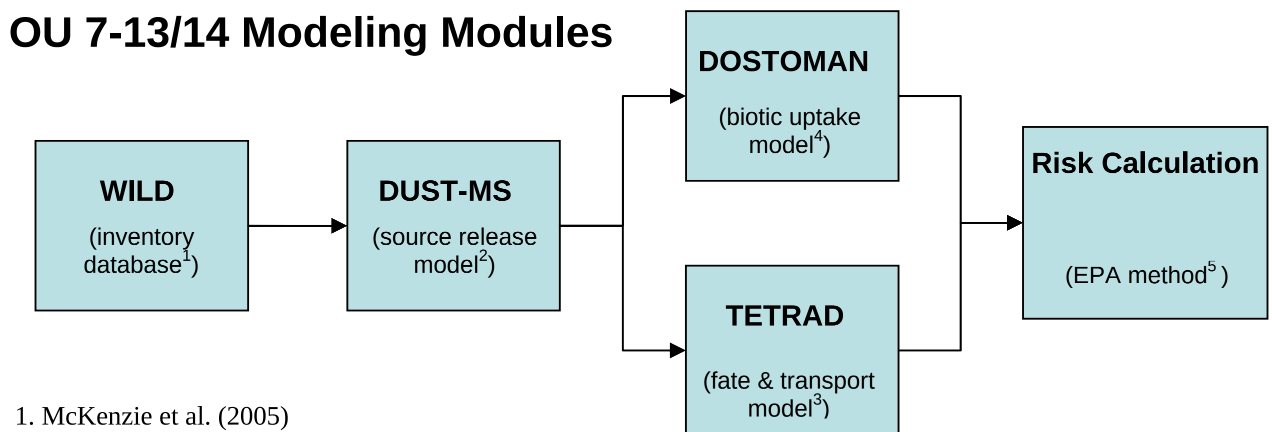
Several reviews have been conducted, but they focused mostly on flow and transport, with very little attention to source release, the most sensitive input to flow and transport. Therefore, a more rigorous review of source-release modeling was solicited, and a panel of independent experts was asked to review the ABRA model and suggest improvements for the remedial investigation. Their results are documented in Kozak, Yim, and Sullivan (2003). They concluded that DUST-MS was an appropriate tool to use and that it was used appropriately to simulate release of contaminants at the SDA. They recommended that any additional work be used to better refine the inventory and release parameters. The inventory evaluation was ongoing, and a contract was awarded to Pacific Northwest National Laboratory to provide an independent recommendation on the release parameters to use in the RI/FS simulations.

In addition to the external reviews, internal reviews were performed. Most of these reviews were performed by the project to determine if DUST-MS was still the appropriate code to use to simulate the release of contaminants into the subsurface. Of note was a review performed not by the project but by Dr. Hull (Appendix D in Holdren and Broomfield [2004]) of the INL Geosciences Department on using DUST-MS to simulate release from grouted waste forms. Dr. Hull concluded that DUST-MS is a suitable model for evaluating the release of contaminants from a grouted waste form and as such would be appropriate to use in evaluating grouting as one of the remedial options evaluated in the feasibility study for OU 7-13/14. His recommendations included better definition of the input parameters used to assess grout. Several studies were performed that provide the basis for the input parameters for the evaluation of grouted waste.

2. MODELING METHODOLOGY AND SIMULATION TOOLS

The RWMC is a complex site. No single model will handle source release, fate and transport, and risk calculations with sufficient detail to be acceptable to DOE, the Idaho Department of Environmental Quality, and the U.S. Environmental Protection Agency; therefore, the modeling is divided into modules, and separate models or tools appropriate for each module are used as follows (see Figure 2-1):

- Waste Inventory and Location Database (WILD) provides the inventory information, in terms of the amount disposed per year for each source area
- DUST-MS computes the release of contaminants due to the shallow subsurface
- TETRAD computes (1) the contaminant concentration movement in the groundwater and (2) the volatile inhalation concentration at the surface
- DOSTOMAN computes the biotic uptake concentrations for the other surface pathways, including: (1) external exposure, (2) crop ingestion, (3) soil ingestion, and (4) dust inhalation
- Risk calculations convert the concentrations, from TETRAD or DOSTOMAN, into a carcinogenic risk or hazard index.



1. McKenzie et al. (2005)
2. Anderson and Becker (2006)
3. Magnuson and Sondrup (2006)
4. Holdren et al. (2005) Draft (see footnote b in Section 3)
5. Engineering design file scheduled for development

Figure 2-1. Operable Unit 7-13/14 risk modeling modules.

This report only addresses the source-release model using DUST-MS.

2.1 Selection of DUST-MS

The DUST-MS source-release computer code (Sullivan 1992; Sullivan 2006) has been used to estimate the mass available for transport at the Subsurface Disposal Area (SDA) for several investigations beginning with the Interim Risk Assessment (IRA) (Becker et al. 1998) in 1995. The source-term model simulates release of contaminants into the subsurface from the waste buried in the SDA. For the remedial investigation and baseline risk assessment (RI/BRA), DUST-MS was again chosen (see Appendix D of

Holdren and Broomfield [2004]) because it has an established acceptance, it maintains consistency with previous simulation efforts, and it was favorably peer-reviewed (Kozak, Yim, and Sullivan 2003).

Before starting what became the IRA (see Section 1.2.3), the tools to use in the modeling for the risk assessment for the remedial investigation were selected. For the source-release and biotic-uptake models, that selection is documented in Becker (1997) and has not changed since. This section summarizes the selection of the source-release modeling tool, DUST-MS.

Model selection was a cooperative effort between DOE, the Idaho Department of Environmental Quality, and the U.S. Environmental Protection Agency. A process was developed to select the modeling tool that included developing a conceptual model, determining criteria for selecting among the various potential tools, and identifying a set of test cases to evaluate model performance of candidate tools that met the criteria.

The conceptual model included the following summary of physical processes to be included in the source-release modeling:

- Episodic infiltration events
- Radioactive progeny
- Time-dependent emplacement of waste
- Various waste forms and containment.

Selection criteria were developed in two categories: required categories and desired categories. The required criteria were:

- Capable of mass balance accounting
- Capable of handling containment failure
- Capable of handling multiple release mechanisms
- Capable of handling radionuclide decay chains
- Compatible with other pathway models
- Well documented.

The desired criteria were:

- Publicly available
- Readily obtainable
- Available source code
- Portable and efficient
- Familiar to relevant modelers.

The literature was reviewed to find potential computer codes for source-release modeling. Modeling tools from both the low-level waste (LLW) performance assessment area and high-level waste performance assessment area were compared to selection criteria. The code BLT-MS was initially chosen for the Waste Area Group 7 baseline risk assessment source-release model. However, problems were encountered with BLT-MS during validation exercises; consequently, a different tool was chosen.

DUST-MS was chosen because it met the criteria and because the interfaces are similar to those already developed for BLT-MS.

A series of test cases was simulated and the results compared to analytical solutions (Becker 1997). These cases used the individual release models in DUST-MS separately and in combination and included radioactive decay as part of the validation.

Since initial selection for the IRA, a review has been performed before each modeling effort to determine if DUST-MS is still an appropriate code to use for source-release modeling. The conclusion was that no tool was substantially better for this task (see Appendix D of Holdren and Broomfield [2004]). The independent review panel (Kozak, Yim, and Sullivan 2003) concluded the same.

2.2 DUST-MS Modifications

Version 1.0 of the DUST-MS code (Sullivan 1993) was selected for the Waste Area Group 7 RI/FS (Becker 1997). Project personnel modified the released version of DUST-MS to account for yearly disposal of waste. While every effort was made to validate the changes, this version obviously differed from the officially released version of DUST-MS. The IRA (Becker et al. 1998) modeled distributed failure of containers by assigning multiple containers, but that methodology did not account for releases limited by solubility. The code author was contracted to modify the code, and a new version of DUST-MS was developed and used for the Ancillary Basis for Risk Analysis (ABRA) (Sullivan 2006). Changes included adding the distributed drum-failure model and yearly waste emplacement. By the end of 2004, due to operating system upgrades to Windows XP, previous versions of DUST-MS would not run. At the beginning of 2005, an updated version (dustmsdx.exe, Version 4.1), modified to run under Windows XP, was obtained from the author. This code was further modified by the Idaho Cleanup Project and designated idustmsdx.exe, Version 4.1d. The modifications included:

- "Hardwiring" input and output filenames to allow batch processing of the simulations.
- Changing the output to write flux (Ci/y or g/y) rather than cumulative release (Ci or g) in the leachtms.dat file for input into the transport simulations. This eliminated precision problems in calculating the flux from the cumulative output and provided more accurate input into the transport simulations.
- Eliminating the "middle" years in the output to the leachrl.dat file. The model output files can be very large. To reduce file size and storage space requirements, only the early years and late years of each simulation were recorded. Intermediate years were not needed and were, therefore, not recorded.
- Changing some "real constants" to "real doubles" to remove compiler "warnings" caused by using a different FORTRAN compiler. This eliminated an inconsistency in variable precision that some compilers fail to notice.

These changes were validated by the project. In addition, identical test cases were compared with the modified and unmodified code to verify that they produced identical results.

2.3 DUST-MS Description

DUST-MS is fully described in Sullivan (2006). This section briefly describes the code. DUST-MS is a FORTRAN program that simulates failure of containers and eventual release of contaminants into the subsurface. DUST-MS is a one-dimensional code that simulates transport vertically. The user can specify the contaminants to be simulated, including decay chains if applicable. DUST-MS allows selecting units for the contaminants (curies or grams). Grams are used for the remedial investigation and feasibility study (RI/FS) simulations because TETRAD needs mass units to compute decay appropriately. Each source area is assigned a surface area, moisture content, and infiltration rate appropriate for the area. These are assigned consistent with the TETRAD grid size and infiltration rates for the grids used. The vertical grid number and size are based on the number of years of disposal. Each year of disposal has a unique grid so that unique container failure and release parameters can be assigned based on the waste forms disposed of. The total depth of the waste zone is divided into the number of grids based on the number of years of waste disposal for the individual source areas.

DUST-MS has several container-failure models: date of failure can be directly input, containers can be failed using a distribution, or the pitting model can be used. For the RI/FS modeling, either no containers were used and the failure time was set to the disposal time, or the distributed failure model was used. For Rocky Flats Plant waste, the Gaussian failure model was used for the drums.

DUST-MS has three release mechanisms—surface wash, diffusion and dissolution:

- The surface-wash model is used to simulate the release of surface contamination on debris. It is a first order partitioning model similar to the soil to water partitioning used in the transport modeling.

- The diffusion model is used for the release of volatile organic compounds (VOCs) from the sludge. The VOCs have to diffuse out of the sludge. Several diffusion models are in DUST-MS, but the analytical model of a cylinder best represents the geometry of drums.

- The dissolution model approximates the corrosion of activated metal and release of contaminants contained in that metal.

3. CONTAMINANTS OF POTENTIAL CONCERN

The Historical Data Task (INEL 1995a) identified 79 chemicals and 100 radionuclides as having been buried in the SDA. The Work Plan for OU 7-13/14 (Becker et al. 1996) screened the contaminants down to 91 for evaluation in the IRA. Contaminants were screened if they produced a risk below 1E-07 or hazard index below 0.1. Of those, 38 were evaluated quantitatively. The remainder lacked sufficient inventory information to evaluate quantitatively. Most were screened qualitatively in the IRA (Becker et al. 1998). The IRA further reduced the list to 29 contaminants evaluated in the Ancillary Basis for Risk Analysis (ABRA) (Holdren et al. 2002). For the draft Remedial Investigation and Baseline Risk Assessment (RI/BRA),[b] 31 contaminants were modeled for source release. The contaminants evaluated increased from 29 to 31 because the ABRA evaluated both the contaminants of potential concern and the long-lived daughter products of some of the radioactive contaminants of potential concern. Section 3 of the draft RI/BRA provides a detailed history of the all of the OU 7-13/14 screening efforts to date.

The contaminants were divided among 11 modeling groups based on common decay chain ancestry or based on other common chemical or physical characteristics. These groups are shown in Table 3-1. Group 9 includes miscellaneous contaminants that were not actually modeled in DUST-MS for source release. Their release was easily modeled through spreadsheet calculations consistent with the updated biotic modeling assumption that all inventory identified as surface wash is immediately available for uptake. The only exposure pathway available to these contaminants is surface exposure, and the only anticipated risk is through biotic uptake. Four contaminants, Nb-94, Sr-90, Cs-137, and Th-228, comprised Group 9. Very little Th-228 was in the SDA buried-waste inventory; however, Th-228 inventories will increase over time through ingrowth attributable to two anthropic predecessor isotopes that are in the SDA inventory. These predecessors are Pu-240 and U-232. Uranium-232 screened out as a risk driver, but its daughter, Th-228, was assessed to be a surface pathway risk and was modeled accordingly. For completeness, contributions from its other predecessor, Pu-240, were included in the risk assessment.

The simulation of entire decay chains allows implementing solubility limits in the modeling. Simulating individual isotopes would allow determining the relative contribution to the total risk from decay and ingrowth, but the contaminants were organized into modeling groups based on either decay chains or common characteristics. The relative contribution from ingrowth can be determined outside of the DUST-MS simulations, and having complete decay chains keeps the solubility calculations consistent. Two of the contaminants, tritium and chromium, were modeled only as model-performance indicators rather than to assess risk; however, tritium failed to adequately indicate modeling performance. Table 3-2 lists half-lives for simulation of radioactive decay. Table 3-3 identifies the screening results, the primary 1,000-year exposure pathway (i.e., which pathway was primarily responsible for retaining the contaminant), and the computer models that were used.

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b. Holdren, K. Jean, Danny L. Anderson, Bruce H. Becker, Nancy L. Hampton, L. Don Koeppen, Swen O. Magnuson, Vivian G. Schultz, A. Jeffrey Sondrup, 2005, *Remedial Investigation and Baseline Risk Assessment for Operable Unit 7-13/14*, DOE/ID-11241, Draft Rev. B, U.S. Department of Energy Idaho Operations Office. This document will be published in 2006.

Table 3-1. Contaminant groups for Operable Unit 7-13/14 simulations.

Simulation Group	Group Name	Contaminants in Group[a]	Description	Basis for Group
1	Am-241	Am-241, Np-237, U-233, and Th-229	Pu-241 decay chain	Neptunium series beginning at Am-241, created by weapons production.
2	Am-243	Am-243, Pu-239, U-235, Pa-231, and Ac-227	Am-243/Pu-239 decay chain	Am-243 to Pu-239, both created primarily by weapons production, to actinium series initiated by U-235.
3	Pu-240	Pu-240, U-236, Th-232, and Ra-228	Pu-240 decay chain	Pu-240 to U-236, created primarily by weapons production to thorium series initiated by Th-232.
4[b]	Pu-238	Pu-238, U-234, Th-230, Ra-226, and Pb-210	Pu-238 decay chain	Pu-238, created primarily by reactor operations, to U-234 to mid-uranium series.
5[b]	U-238	U-238, U-234, Th-230, Ra-226, and Pb-210	Uranium decay chain	Uranium series initiated by U-238, primarily from weapons production.
6	Tc-99	Tc-99, I-129, and Cl-36	Mobile activation products	Created by reactor operations.
8[c]	C-14	C-14	Mobile, dual-phase[d] activation product	Requires dual-phase simulation. Created by reactor operations.
9	Nb-94	Nb-94, Sr-90, Cs-137, and Th-228	Fission and activation products	Surface pathways only. Created by reactor operations.[e]
10	Nitrate	Nitrate (as nitrogen) and chromium	Toxic chemicals	Nonvolatile (single-phase), nonradioactive chemicals. Nitrate is contained primarily in Series 745 sludge from Rocky Flats Plant. Mobile with no decay. Chromium is a possible model performance indicator.
11	Volatile organic compound	Carbon tetrachloride, methylene chloride, tetrachloroethylene, trichloroethylene,[f] and 1,4-dioxane	Toxic, dual-phase[d] chemicals in organic sludge	Volatile (dual-phase) nonradioactive chemicals. Scaled Interim Risk Assessment results in the Ancillary Basis for Risk Analysis.

a. Simulations include contaminants that are not contaminants of potential concern. These additional contaminants are decay-chain products or are useful for other reasons (e.g., comparison to performance assessment modeling and interpreting model performance and uncertainty).
b. Groups 4 and 5 both contain U-234, Th-230, Ra-226, and Pb-210.
c. Group 7 was reserved for tritium, which was dropped as a model performance indicator.
d. Dual-phase refers to simultaneous transport in both vapor and liquid phases.
e. Th-232 is not directly created by reactor operations, but is a progeny in two decay chains for isotopes that are produced in a reactor (Pu-240 and U-232).
f. Simulations for trichloroethylene will be part of the feasibility study.

Table 3-2. Radioisotope half-lives.

Isotope	Half-life[a] (yr)	Isotope	Half-life[a] (yr)
Ac-227	2.18E+01	Pu-240	6.54E+03
Am-241	4.32E+02	Ra-226	1.60E+03
Am-243	7.38E+03	Ra-228	5.75E+00
C-14	5.73E+03	Sr-90	2.91E+01
Cl-36	3.01E+05	Tc-99	2.13E+05
Cs-137	3.02E+01	Th-228	1.91E+00
I-129	1.57E+07	Th-232	1.41E+10
Nb-94	2.03E+04	U-232	7.20E+01
Np-237	2.14E+06	U-233	1.59E+05
Pa-231	3.28E+04	U-234	2.45E+05
Pb-210	2.23E+01	U-235	7.04E+08
Pu-238	8.77E+01	U-236	2.34E+07
Pu-239	2.41E+04	U-238	4.47E+09

a. Values from Health Effects Assessment Summary Tables – Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors (EPA 2001).

Table 3-3. Contaminants evaluated and the computer models used to assess them.

Contaminant	Screening Results	Primary 1,000-year Exposure Pathway	Computer Models		
			DUST-MS	TETRAD	DOSTOMAN
Ac-227	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
Am-241	Contaminant of potential concern	Soil ingestion, inhalation, external exposure, and crop ingestion	Yes	Yes	Yes
Am-243	Long-lived parent of Pu-239	External exposure	Yes	Yes	Yes
C-14	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
Chromium	Model performance indicator	NA	Yes	Yes	No
Cl-36	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
Cs-137	Contaminant of potential concern	External exposure	Yes	No	Yes
I-129	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
Nb-94	Contaminant of potential concern	External exposure	Yes	Yes	Yes
Np-237	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
Pa-231	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
Pb-210	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
Pu-238	Contaminant of potential concern and long-lived parent of U-234	Soil and crop ingestion	Yes	Yes	Yes
Pu-239	Contaminant of potential concern	Soil and crop ingestion	Yes	Yes	Yes
Pu-240	Contaminant of potential concern	Soil and crop ingestion	Yes	Yes	Yes
Ra-226	Contaminant of potential concern	External exposure	Yes	Yes	Yes
Ra-228	Contaminant of potential concern	External exposure	Yes	Yes	Yes
Sr-90	Contaminant of potential concern for surface exposure pathways only	Crop ingestion	Yes	No	Yes
Tc-99	Contaminant of potential concern	Groundwater ingestion and crop ingestion	Yes	Yes	Yes
Th-228	Contaminant of potential concern	External exposure	Yes	No	Yes
Th-229	Long-lived progeny of U-233	Groundwater ingestion	Yes	Yes	Yes
Th-230	Long-lived progeny of U-234	Groundwater ingestion	Yes	Yes	Yes
Th-232	Long-lived progeny of U-236	Crop ingestion	Yes	Yes	Yes

Table 3-3. (continued).

Contaminant	Screening Results	Primary 1,000-year Exposure Pathway	Computer Models		
			DUST-MS	TETRAD	DOSTOMAN
U-232	Parent of contaminant of potential concern (Th-228)	External exposure	Yes	No	Yes
U-233	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
U-234	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
U-235	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
U-236	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
U-238	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
Nitrate	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	Yes
Carbon tetrachloride	Contaminant of potential concern	Inhalation and groundwater ingestion	Yes	Yes	No
Methylene chloride	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	No
Tetrachloroethylene	Contaminant of potential concern	Groundwater ingestion and dermal exposure to contaminated water	Yes	Yes	No
Trichloroethylene	Contaminant of potential concern	Inhalation and groundwater ingestion	Yes	Yes	No
1,4-Dioxane	Contaminant of potential concern	Groundwater ingestion	Yes	Yes	No

NA = not applicable

4. REMEDIAL INVESTIGATION MODEL

This section details the model used to simulate the release of contaminants into the subsurface. The conceptual model is presented followed by the inventory. This information is combined with the waste form information to develop contaminant-specific release simulations. The base case for the remedial investigation includes 58 years of disposal, the grouting of beryllium blocks, and the Accelerated Retrieval Project retrieval. The Accelerated Retrieval Project is a non-time-critical removal action, involving the retrieval of targeted waste from half an acre in Pit 4, intended to prove the feasibility of targeted retrievals. The need for any additional remedial actions will be developed as part of the record of decision.

4.1 Source-Term Conceptual Model

The remedial investigation and baseline risk assessment (RI/BRA) conceptual model for the source term remains simple. Waste is assumed to be buried either without containers or in containers. Contaminants not in containers are available for immediate release. Once the containers fail, the remaining contaminants are available for release. Waste in wooden or cardboard boxes is assumed to be without a container due to the relatively short life span of such containers. All other waste containers are assumed to be steel drums. Two different failure distributions for steel drums are used, depending on whether the drums were randomly dumped or neatly stacked. Depending on the waste form and contaminant, the release can be rapid or very slow. Once the mass is released from the waste form, it is available for transport.

To account for the grouting of the beryllium blocks and the Accelerated Retrieval Project retrievals, the simulations are stopped at the year 2004 and restarted with the Accelerated Retrieval Project mass removed and the appropriate portion of the beryllium block mass grouted. The grouting does not remove source mass but does modify the release rate. It is assumed that the grout covers 80% of the surface area of the beryllium blocks. Therefore, the surface in contact with water to cause the corrosion is 20% of the ungrouted value. The grouted release rate is 20% of the ungrouted rate for the period when the grout is assumed to remain effective. Although the Accelerated Retrieval Project and grouting occur over a few years, they are modeled as though they occur instantaneously.

The beryllium reflector blocks from the research reactors at Reactor Technology Complex (formerly called Test Reactor Area) were grouted as a non-time critical removal action (Lopez 2004). Three different reactors had beryllium reflector blocks that were disposed of in the SDA. Table 4-1 lists the reactor, disposal date, C-14 curies disposed of, whether the blocks were grouted, and the location of the disposal. The location of the Advanced Test Reactor Core 1 shipment in 1973 and the Advanced Test Reactor Core 2 shipments were not identified before the non-time critical removal action. Consequently, 86.3 of the 92.4 curies of C-14 in the beryllium blocks were grouted, and credit is taken in the risk model for only grouting the 86.3 curies. Grout demonstrations have been shown to be highly effective (Loomis 2002), but without actual field validation, it was conservative to assume that only 80% of the blocks that were grouted were encapsulated. It is assumed that the 20% of the surface area not encapsulated is in contact with water and continues to corrode at the original rate. In effect, the corrosion rate of the grouted blocks is reduced to 20% of the original ungrouted value. In reality, encapsulation is likely much higher, and a large amount of grout returns at the surface, which would provide an effective barrier to water infiltration. No credit is taken for this barrier. The ungrouted blocks corrode at the original rate.

Table 4-1. Beryllium blocks disposed of in the Subsurface Disposal Area.

Generator	Date	C-14 (Ci)	Grouted	Location
MTR Core 1	1977	2.92E+01	Y	T 52, 58
ETR Core 1	1970	2.17E+01	Y	T54
ATR Core 1	1973	3.00E-01	N	T57
ATR Core 1	1976	7.51E+00	Y	T58
ATR Core 2	1977	5.83E+00	N	SVR 12
ATR Core 3	1993	1.20E+01	Y	SVR 20
ATR OSCC	1987	1.59E+01	Y	SVR 17

ATR = Advanced Test Reactor
ETR = Engineering Test Reactor
MTR = Materials Testing Reactor
OSCC = outer shim control cylinder

4.2 Inventory

The inventory is the starting point for the source-release model. It is the definition of how much of the contaminant was buried. The inventory will determine the period of contaminant release, subject to the rate of release.

For the remedial investigation, the best inventory information available in the Waste Information and Location Database (WILD) (McKenzie et al. 2005) as of October 12, 2004, was used for the simulations. Continued validation of the database might cause minor changes to the values in Tables 4-2, 4-3, 4-4, and 4-5. Additional information regarding the inventory used follows:

- All inventories listed in the following tables represent estimates at time of disposal.

- DUST-MS Version 4 included a modification that allows assigning different disposal years for each waste package, where each package is represented by a layer. In OU 7-13/14 source-release modeling, these layers are used to simulate years of disposal, with the deepest layer being the first year of disposal and subsequent years stacking on top of prior years.

- Projections for the Low-Level Waste (LLW) Pit are included for operations through 2009.

- Inventory estimates are presented by waste stream for each of the contaminants of potential concern. Inventory estimates also are included for three noncontaminants of potential concern: Pu-241 and Pu-242, which are decayed to and modeled as Am-241 and U-238, respectively, and chromium, which was used to assess dissolved-phase model performance.

- With one exception, all anticipated adjustments to original inventories at time of disposal are reflected in Tables 4-2, 4-3, 4-4, and 4-5. The exception is inventory reductions attributable to the Accelerated Retrieval Project in the prescribed area in Pit 4. Mass simulated as retrieved in the Accelerated Retrieval Project is provided in Tables 4-6 and 4-7.

Table 4-2. Radiological waste streams, best-estimate inventories (curies) at time of disposal, and baseline source-release information for Operable Unit 7-13/14 modeling.

Contaminant	Waste Stream Code	Percentage in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
Ac-227	INTEC-MOD-9H	18.0	7.68E-07	General plant waste (e.g., metal, glass, paper, metal, wood, clothing, plastic, dirt, and shielding material) (1952–1983)	Surface wash	2.25E+02	mL/g	Distribution coefficient	No containment
	TRA-670-1N	16.9	7.19E-07	Beryllium waste	Surface wash	2.25E+02	mL/g	Distribution coefficient	No containment
	CFA-690-1	16.4	7.00E-07	Metal—stainless steel	Surface wash	2.25E+02	mL/g	Distribution coefficient	No containment
	INTEC-MOD-5H	10.1	4.32E-07	HEPA filter from Waste Calcining Facility and other filters from miscellaneous facilities	Surface wash	2.25E+02	mL/g	Distribution coefficient	No containment
	INTEC-MOD-6H	6.3	2.68E-07	CPP-603 resins (i.e., basin sludge and miscellaneous storage basin Zeolite filters)	Surface wash	2.25E+02	mL/g	Distribution coefficient	No containment
	INTEC-MOD-7H	6.2	2.63E-07	Contaminated soil from Tank Farm spills	Surface wash	2.25E+02	mL/g	Distribution coefficient	No containment
	TAN-607-3N	5.7	2.45E-07	Activated core, loop components, end boxes, and stainless steel from SL-1 reactor	Surface wash	2.25E+02	mL/g	Distribution coefficient	
	TAN-633-5N	5.0	2.14E-07	Material as core structures, piping, clad assemblies, stainless steel, and combustible waste	Surface wash	2.25E+02	mL/g	Distribution coefficient	No containment
	CFA-RWM-1	4.9	2.07E-07	Central Facilities Area Sewage Treatment Plant unpainted concrete rubble, drying beds soils, clarifier piping, and trickle filter bricks	Surface wash	2.25E+02	mL/g	Distribution coefficient	No containment
	INTEC-MOD-4H	2.4	1.03E-07	One-time-only Navy experiment	Surface wash	2.25E+02	mL/g	Distribution coefficient	No containment
	TAN-607-6RN	1.7	7.09E-08	Metal alloys, end boxes, combustible material, fuel assembly shrouds, concrete, resin, sludge, and equipment from Hot Shop and Hot Cells (1984–1993)	Surface wash	2.25E+02	mL/g	Distribution coefficient	3% drums, 97% other
	TAN-633-2N	1.5	6.24E-08	Hot shop waste.	Surface wash	2.25E+02	mL/g	Distribution coefficient	No containment
	D&D-ARA-1	1.2	5.23E-08	Waste stream consists primarily of contaminated metal and debris	Surface wash	2.25E+02	mL/g	Distribution coefficient	No containment
	INTEC-MOD-2H	1.1	4.69E-08	Leached Vycor glass	Surface wash	2.25E+02	mL/g	Distribution coefficient	No containment
	Miscellaneous[c]	2.6	1.06E-07	—	—	—	—	—	—
Total Ac-227		**100**	**4.26E-06**						
Am-241	RFO-DOW-3H	77.8	1.89E+05	Uncemented sludge	Surface wash	2.25E+02	mL/g	Distribution coefficient	99.8% drums, 0.2% wooden boxes
	RFO-DOW-4H	13.4	3.26E+04	Paper, rags, plastic, clothing, wood, and polyethylene bottles	Surface wash	2.25E+02	mL/g	Distribution coefficient	70% drums, 30% wooden boxes
	Pu-241 ingrowth	5.2	1.27E+04	Various Rocky Flats Plant waste streams	Surface wash	2.25E+02	mL/g	Distribution coefficient	

Table 4-2. (continued).

Contaminant	Waste Stream Code	Percentage in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
	RFO-DOW-12H	2.6	6.26E+03	Dirt, concrete, ash, and soot	Surface wash	2.25E+02	mL/g	Distribution coefficient	81% drums, 19% wooden boxes
	RFO-DOW-6H	0.9	2.01E+03	Filters	Surface wash	2.25E+02	mL/g	Distribution coefficient	Wooden or cardboard boxes
	Miscellaneous[c]	0.1	3.02E+02	Various waste types	—	—	—	—	—
Total Am-241		**100.0**	**2.43E+05**						
C-14	TRA-603-4N	46.0	3.36E+02	Core components	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	13% drums, 87% other
	TRA-670-1N	12.7	9.31E+01	Beryllium waste	Dissolution	2.65E-03	1/year	Beryllium fractional corrosion rate	No containment
	LLW—metal	9.8	7.17E+01	2000–2009 activated metal	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	No containment
	TRA-632-2N	7.8	5.72E+01	Hot Cell waste	Surface wash	4.00E-01	mL/g	Distribution coefficient	24% drums, 76% other
	NRF-MOD-6H	5.2	3.82E+01	Core structural materials (1953–1983)	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	17% drums, 83% other
	TRA-603-27N	3.8	2.81E+01	Noncompactable waste (e.g., metal, wood, and glass)	Surface wash	4.00E-01	mL/g	Distribution coefficient	No containment
	NRF-MOD-9H	2.3	1.65E+01	Sludge and resins from Expended Core Facility and prototype plant operations (1953–1971)	Surface wash	1.90E+01	mL/g	Resins distribution coefficient	18% drums, 82% other
	ANL-MOD-1H	2.2	1.60E+01	Irradiated subassembly hardware (1977–1983)	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	9% drums, 91% other
	ANL-MOD-1R	2.1	1.53E+01	Irradiated subassembly hardware (1984–1993)	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	No containment
	LLW—resins	1.1	7.87E+00	2000–2009 resins	Surface wash	1.90E+01	mL/g	Resins distribution coefficient	No containment
	TRA-603-28N	1.0	7.40E+00	Miscellaneous contaminated materials	Surface wash	4.00E-01	mL/g	Distribution coefficient	No containment
	ANL-785-1	1.0	7.11E+00	Subassembly waste from nuclear fuel and materials experiments in the Hot Fuel Examination Facility (1994–1999)	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	No containment
	Miscellaneous[c]	5.0	3.67E+01	Mostly activated metal	—	—	—	—	—
Total C-14		**100.0**	**7.31E+02**						
Cl-36	TRA-670-1N	53.3	8.83E-01	Beryllium waste	Dissolution	2.65E-03	1/year	Beryllium fractional corrosion rate	No containment
	LLW—metal	32.5	5.38E-01	2000–2009 activated metal	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	No containment
	NRF-MOD-6H	9.5	1.58E-01	Core structural materials (1953–1983)	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	17% drums, 83% other

Table 4-2. (continued).

Contaminant	Waste Stream Code	Percentage in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
	NRF-MOD-6R	2.7	4.49E-02	Core structural materials (1984–1997)	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	No containment
	Miscellaneous[c]	2.0	3.32E-02	Mostly activated metal	—	—	—	—	—
Total Cl-36		**100.0**	**1.66E+00**						
Cs-137	INTEC-MOD-2H	27.9	4.69E+04	Leached Vycor glass	Dissolution	1.30E-05	1/year	Vycor glass fractional corrosion rate	No containment
	OFF-ATI-1H	13.3	2.23E+04	Irradiated fuel and chemical byproducts from nuclear research	Surface wash	1.00E+03	mL/g	Distribution coefficient	36% drums, 64% other
	TRA-632-2N	9.8	1.64E+04	Hot Cell waste	Surface wash	1.00E+03	mL/g	Distribution coefficient	24% drums, 76% other
	ANL-MOD-5H	8.3	1.39+E+04	General plant waste, mostly from decontamination (1952–1983)	Surface wash	1.00E+03	mL/g	Distribution coefficient	6% drums, 94% other
	NRF-MOD-1H	6.3	1.06+E04	Shippingport fuel material, solid (1960–1968)	Dissolution	3.47E-02[d]	1/year	Nuclear fuels fractional corrosion rate	No containment
	INTEC-MOD-9H	4.8	8.00E+04	General plant waste (e.g., metal, glass, paper, metal, wood, clothing, plastic, dirt, and shielding material) (1952–1983)	Surface wash	1.00E+03	mL/g	Distribution coefficient	2% drums, 98% other
	TRA-603-9N	3.8	6.43E+03	Fuel materials (solids, not dissolved)	Dissolution	3.47E-02[d]	1/year	Nuclear fuels fractional corrosion rate	8% drums, 92% other
	ANL-MOD-2H	2.9	4.82E+03	Irradiated and unirradiated fuel specimens (1971–1983)	Surface wash	1.00E+03	mL/g	Distribution coefficient	7% drums, 93% other
	TRA-603-28N	2.7	4.53+E03	Miscellaneous contaminated materials	Surface wash	1.00E+03	mL/g	Distribution coefficient	No containment
	INTEC-MOD-5H	2.7	4263E+03	HEPA filter from Waste Calcining Facility and other filters from miscellaneous facilities	Surface wash	1.00E+03	mL/g	Distribution coefficient	No containment
	ANL-MOD-3H	2.5	4.51E+03	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1952–1970)	Surface wash	1.00E+03	mL/g	Distribution coefficient	6% drums, 94% other
	INTEC-MOD-6H	2.5	4.12E+03	CPP-603 resins (i.e., basin sludge and miscellaneous storage basin Zeolite filters)	Surface wash	1.00E+03	mL/g	Distribution coefficient	No containment
	ANL-MOD-2HEXT	2.4	4.00E+03	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1984-1993)	Surface wash	1.00E+03	mL/g	Distribution coefficient	No containment
	TAN-607-3N	2.3	3.86E+03	Activated core, loop components, end boxes, and stainless steel from SL-1 reactor	Surface wash	1.00E+03	mL/g	Distribution coefficient	No containment
	INTEC-MOD-7H	1.6	2.77E+03	Contaminated soil from Tank Farm spills	Surface wash	1.00E+03	mL/g	Distribution coefficient	No containment
	Miscellaneous[c]	6.2	1.05E+04	Various waste types	—	—	—	—	—
Total Cs-137		**100.0**	**1.67E+05**						
I-129	TRA-603-1N	44.6	8.38E-02	Resins	Surface wash	1.90E+01	mL/g	Resins distribution coefficient	No containment
	LLW—resins	24.8	4.65E-02	2000–2009 resins	Surface wash	1.90E+01	mL/g	Resins distribution coefficient	No containment
	INTEC-MOD-2H	9.6	1.80E-02	Leached Vycor glass	Dissolution	1.30E-05	1/year	Vycor glass fractional corrosion rate	No containment

Table 4-2. (continued).

Contaminant	Waste Stream Code	Percentage in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
	NRF-MOD-10H	2.5	4.78E-03	Compactable and noncompactable waste from Expended Core Facility and prototype plant operations (1952–1983)	Surface wash	0.00E+00	mL/g	Distribution coefficient	7% drums, 93% other
	TRA-632-2N	2.3	4.27E-03	Hot Cell waste	Surface wash	0.00E+00	mL/g	Distribution coefficient	24% drums, 76% other
	NRF-MOD-1H	2.1	3.90E-03	Shippingport fuel material, solid (1960–1968)	Dissolution	3.47E-02[d]	1/year	Nuclear fuels fractional corrosion rate	No containment
	ANL-MOD-5H	1.9	3.52E-03	General plant waste, mostly from decontamination (1952–1983)	Surface wash	0.00E+00	mL/g	Distribution coefficient	6% drums, 94% other
	LLW—trash	1.4	2.71E-03	2000–2009 miscellaneous LLW	Surface wash	0.00E+00	mL/g	Distribution coefficient	No containment
	INTEC-MOD-9H	1.4	2.56E-03	General plant waste (e.g., metal, glass, paper, metal, wood, clothing, plastic, dirt, and shielding material) (1952–1983)	Surface wash	0.00E+00	mL/g	Distribution coefficient	2% drums, 98% other
	TRA-603-28N	1.3	2.38E-03	Miscellaneous contaminated materials	Surface wash	0.00E+00	mL/g	Distribution coefficient	No containment
	PBF-620-1	1.0	1.90E-03	Ion exchange resins	Surface wash	1.90E+01	mL/g	Resins distribution coefficient	No containment
	Miscellaneous[c]	7.1	1.34E-02	Mostly fuel-contaminated waste	—	—	—	—	—
Total I-129		**100.0**	**1.88E-01**						
Nb-94	TRA-603-4N	45.5	6.63E+01	Core components	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	13% drums, 87% other
	NRF-MOD-10H	16.5	2.40E+01	Compactable and noncompactable waste from Expended Core Facility and prototype plant operations (1952–1983)	Surface wash	5.00E+02	mL/g	Distribution coefficient	7% drums, 93% other
	TRA-632-2N	9.5	1.39E+01	Hot Cell waste	Surface wash	5.00E+02	mL/g	Distribution coefficient	24% drums, 76% other
	LLW—resins	6.2	8.94E+00	2000–2009 resins	Surface wash	5.00E+02	mL/g	Distribution coefficient	No containment
	TRA-603-27N	4.7	6.83E+00	Noncompactable waste (e.g., metal, wood, and glass)	Surface wash	5.00E+02	mL/g	Distribution coefficient	No containment
	NRF-MOD-6H	3.5	5.06E+00	Core structural materials (1953–1983)	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	17% drums, 83% other
	LLW—metal	1.9	2.83E+00	2000–2009 activated metal	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	No containment
	TRA-603-1N	1.9	2.82E+00	Resins	Surface wash	5.00E+02	mL/g	Distribution coefficient	No containment
	ANL-MOD-1H	1.9	2.81E+00	Irradiated subassembly hardware (1977–1983)	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	9% drums, 91% other
	ANL-MOD-1R	1.8	2.55E+00	Irradiated subassembly hardware (1984–1993)	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	No containment
	D+D-S1G-1H	1.4	2.00E+00	Decontaminated reactor vessel and processing equipment, components, and piping	Surface wash	5.00E+02	mL/g	Distribution coefficient	No containment
	TRA-603-28N	1.2	1.79E+00	Miscellaneous contaminated materials	Surface wash	5.00E+02	mL/g	Distribution coefficient	No containment

Table 4-2. (continued).

Contaminant	Waste Stream Code	Percentage in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
	TRA-603-9N	1.0	1.50E+00	Fuel materials (solids, not dissolved)	Dissolution	3.47E-02[d]	1/year	Nuclear fuels fractional corrosion rate	8% drums, 92% other
	Miscellaneous[c]	3.0	4.26E+00	Various waste types	—	—	—	—	—
Total Nb-94		**100.0**	**1.46E+02**						
Np-237	TRA-632-2N	24.9	3.52E-02	Hot Cell waste	Surface wash	2.30E+01	mL/g	Distribution coefficient	24% drums, 76% other
	LLW—trash	16.1	2.28E-02	2000–2009 miscellaneous LLW	Surface wash	2.30E+01	mL/g	Distribution coefficient	No containment
	TRA-603-28N	13.9	1.96E-02	Miscellaneous contaminated materials	Surface wash	2.30E+01	mL/g	Distribution coefficient	No containment
	TRA-603-9N	8.9	1.26E-02	Fuel materials (solids, not dissolved)	Surface wash	2.30E+01	mL/g	Distribution coefficient	8% drums, 92% other
	ANL-MOD-5H	7.9	1.12E-02	General plant waste, mostly from decontamination (1952–1983)	Surface wash	2.30E+01	mL/g	Distribution coefficient	6% drums, 94% other
	ANL-763-1	5.4	7.55E-03	Soil, rocks, concrete, and sludge solidified with grout from cleanup of Experimental Breeder Reactor II leach pit	Surface wash	2.30E+01	mL/g	Distribution coefficient	No containment
	ANL-MOD-4H	3.1	4.37E-03	Low or unirradiated bulk-actinide waste	Surface wash	2.30E+01	mL/g	Distribution coefficient	25% drums, 75% other
	ANL-MOD-2H	2.7	3.88E-03	Irradiated and unirradiated fuel specimens (1971–1983)	Surface wash	2.30E+01	mL/g	Distribution coefficient	7% drums, 93% other
	ANL-MOD-3H	2.4	3.43E-03	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1952–1970)	Surface wash	2.30E+01	mL/g	Distribution coefficient	6% drums, 94% other
	ANL-MOD-2HEXT	2.3	3.23E-03	Irradiated and unirradiated fuel and fuel-contaminated materials (1984–1993)	Surface wash	2.30E+01	mL/g	Distribution coefficient	No containment
	INTEC-MOD-9H	1.9	2.72E-03	General plant waste (e.g., metal, glass, paper, metal, wood, clothing, plastic, dirt, and shielding material) (1952–1983)	Surface wash	2.30E+01	mL/g	Distribution coefficient	2% drums, 98% other
	NRF-MOD-1H	1.9	2.66E-03	Shippingport fuel material, solid (1960–1968)	Surface wash	2.30E+01	mL/g	Distribution coefficient	No containment
	INTEC-MOD-5H	1.1	1.53E-03	HEPA filter from Waste Calcining Facility and other filters from miscellaneous facilities	Surface wash	2.30E+01	mL/g	Distribution coefficient	No containment
	Miscellaneous[c]	7.5	1.05E-02	Various waste types	—	—	—	—	—
Total Np-237		**100.0**	**1.41E-01**						
Pa-231	D&D-ARA-1	97.2	8.56E-04	Waste stream consists primarily of contaminated metal and debris	Surface wash	8.00E+00	mL/g	Distribution coefficient	No containment
	Miscellaneous[c]	2.8	2.46E-05	Various waste types	—	—	—	—	—
Total Pa-231			**8.81E-04**						
Pb-210	WER-CMP-1	90.4	5.08E-07	Compacted waste: combination of glass, plastic, absorbents, cloth, paper, and wood	Surface wash	2.70E+02	mL/g	Distribution coefficient	No containment
	INTEC-MOD-9H	3.7	2.08E-08	General plant waste 1952 through 1983; consists of metal, glass, paper, metal, wood, clothing, plastic, dirt, and shielding material	Surface wash	2.70E+02	mL/g	Distribution coefficient	2% drums, 98% other

Table 4-2. (continued).

Contaminant	Waste Stream Code	Percentage in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
	INTEC-MOD-5H	2.1	1.17E-08	HEPA filter from Waste Calcining Facility and other filters from miscellaneous facilities	Surface wash	2.70E+02	mL/g	Distribution coefficient	No containment
	INTEC-MOD-7H	1.3	7.27E-09	Contaminated soil from Tank Farm spills	Surface wash	2.70E+02	mL/g	Distribution coefficient	No containment
	Miscellaneous[c]	2.5	1.41E-08	Various waste types	—	—	—	—	—
Total Pb-210		**100.0**	**5.62E-07**						
Pu-238	Rocky Flats	88.7	1.85E+03	See Rocky Flats Plant plutonium table	Surface wash	2.50E+03	mL/g	Distribution coefficient	
	TRA-632-2N	3.2	6.68E+01	Hot Cell waste	Surface wash	2.50E+03	mL/g	Distribution coefficient	24% drums, 76% other
	TRA-603-28N	1.8	3.72E+01	Miscellaneous contaminated materials	Surface wash	2.50E+03	mL/g	Distribution coefficient	No containment
	INTEC-MOD-9H	1.6	3.36E+01	General plant waste (e.g., metal, glass, paper, metal, wood, clothing, plastic, dirt, and shielding material) (1952–1983)	Surface wash	2.50E+03	mL/g	Distribution coefficient	2% drums, 98% other
	TRA-603-9N	1.2	2.39E+01	Fuel materials (solids, not dissolved)	Surface wash	2.50E+03	mL/g	Distribution coefficient	8% drums, 92% other
	Miscellaneous[c]	3.5	7.30E+01	Mostly debris, some fuel-contaminated waste	—	—	—	—	—
Total Pu-238		**100.0**	**2.08E+03**						
Pu-239	Rocky Flats	94.7	6.07E+04	See Rocky Flats Plant plutonium, Table 4-3	Surface wash	2.50E+03	mL/g	Distribution coefficient	Mixed drums and other containers
	Rocky Flats	3.6	2.33E+03	See Rocky Flats Plant plutonium, Table 4-3	Surface wash	0.00E+00	mL/g	Distribution coefficient	Mixed drums and other containers
	Miscellaneous[c]	1.7	1.08E+03	Mostly fuel-contaminated waste	—	—	—	—	—
Total Pu-239		**100.0**	**6.41E+04**						
Pu-240	Rocky Flats	93.0	1.35E+04	See Rocky Flats Plant plutonium, Table 4-3	Surface wash	2.50E+03	mL/g	Distribution coefficient	Mixed drums and other containers
	Rocky Flats	3.6	5.20E+02	See Rocky Flats Plant plutonium, Table 4-3	Surface wash	0.00E+00	mL/g	Distribution coefficient	Mixed drums and other containers
	OFF-LRL-2H	3.1	4.49E+02	Concrete, bricks, and asphalt	Surface wash	2.50E+03	mL/g	Distribution coefficient	Drums
	Miscellaneous[c]	0.3	5.39E+01	Various waste types	—	—	—	—	—
Total Pu-240		**100.0**	**1.46E+04**						
Ra-226	OFF-USN-1H	66.4	4.33E+01	Animal carcasses, waste paper towels, glassware, tools, and similar laboratory items	Surface wash	5.75E+02	mL/g	Distribution coefficient	12% drums, 88% other
	OFF-ISC-1H	15.3	1.00E+01	Magnesium-thorium scrap, laboratory equipment, and sources	Surface wash	5.76E+02	mL/g	Distribution coefficient	75% drums, 25% other
	OFF-AEF-1H	10.2	6.67E+00	Scrap metal, combustibles, glass, and concrete	Surface wash	5.75E+02	mL/g	Distribution coefficient	91% drums, 9% other
	OFF-DPG-1H	5.1	3.33E+00	Animal and laboratory waste	Surface wash	5.75E+02	mL/g	Distribution coefficient	92% drums, 8% other

Table 4-2. (continued).

Contaminant	Waste Stream Code	Percentage in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
	OFF-HEW-1H	1.5	1.00E+00	Radium-contaminated laboratory waste	Surface wash	5.75E+02	mL/g	Distribution coefficient	Drums
	Miscellaneous[c]	1.5	9.50E-01	Various waste types	—	—	—	—	—
Total Ra-226		**100.0**	**6.53E+01**						
Ra-228	Projected	70.3	2.57E-05	Projected waste	Surface wash	5.75E+02	mL/g	Distribution coefficient	No containment
	WER-CMP-1	29.3	1.07E-05	Compacted waste: combination of glass, plastic, absorbents, cloth, paper, and wood	Surface wash	5.75E+02	mL/g	Distribution coefficient	No containment
	Miscellaneous[c]	0.4	1.55E-07	Various waste types	—	—	—	—	—
Total Ra-228		**100.0**	**3.66E-05**						
Sr-90	INTEC-MOD-2H	31.3	4.26E+04	Leached Vycor glass	Dissolution	1.30E-05	1/year	Vycor glass fractional corrosion rate	No containment
	TRA-632-2N	12.7	1.73E+04	Hot Cell waste	Surface wash	6.00E+01	mL/g	Distribution coefficient	24% drums, 76% other
	ANL-MOD-5H	7.4	1.01E+04	General plant waste, mostly from decontamination (1952–1983)	Surface wash	6.00E+01	mL/g	Distribution coefficient	6% drums, 94% other
	TRA-603-28N	7.1	9.62E+03	Miscellaneous contaminated materials	Surface wash	6.00E+01	mL/g	Distribution coefficient	No containment
	INTEC-MOD-9H	5.9	8.00E+03	General plant waste (e.g., metal, glass, paper, metal, wood, clothing, plastic, dirt, and shielding material) (1952–1983)	Surface wash	6.00E+01	mL/g	Distribution coefficient	2% drums, 98% other
	NRF-MOD-1H	4.6	6.24E+03	Shippingport fuel material, solid (1960–1968)	Dissolution	3.47E-02[d]	1/year	Nuclear fuels fractional corrosion rate	No containment
	TRA-603-9N	4.5	6.18E+03	Fuel materials (solid, not dissolved)	Dissolution	3.47E-02[d]	1/year	Nuclear fuels fractional corrosion rate	8% drums, 92% other
	INTEC-MOD-5H	3.3	4.51E+03	HEPA filter from Waste Calcining Facility and other filters from miscellaneous facilities	Surface wash	6.00E+01	mL/g	Distribution coefficient	No containment
	INTEC-MOD-6H	3.1	4.24E+03	CPP-603 resins (i.e., basin sludge and miscellaneous storage basin Zeolite filters)	Surface wash	6.00E+01	mL/g	Distribution coefficient	No containment
	ANL-MOD-2H	2.6	3.48E+03	Irradiated and unirradiated fuel specimens (1971–1983)	Dissolution	3.47E-02[d]	1/year	Nuclear fuels fractional corrosion rate	7% drums, 93% other
	ANL-MOD-3H	2.3	3.08E+03	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1952-1970)	Surface wash	6.00E+01	mL/g	Distribution coefficient	6% drums, 94% other
	ANL-MOD-2HEXT	2.1	2.90E+03	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1984-1993)	Surface wash	6.00E+01	mL/g	Distribution coefficient	No containment
	INTEC-MOD-7H	2.0	2.78E+03	Contaminated soil from Tank Farm spills	Surface wash	6.00E+01	mL/g	Distribution coefficient	No containment
	ARA-616-1H	1.6	2.16E+03	Scrap metal, resin, burnable materials, sludge, and some boric acid crystals from Mobile Low-Power Reactor No. 1 and Gas-Cooled Reactor Experiment	Surface wash	6.00E+01	mL/g	Distribution coefficient	1% drums, 99% other
	TAN-607-6RN	1.2	1.65E+03	Metal alloys, end boxes, combustible material, fuel assembly shrouds, concrete, resin, sludge, and equipment from Hot Shop and Hot Cells (1984–1993)	Surface wash	6.00E+01	mL/g	Distribution coefficient	3% drums, 97% other

Table 4-2. (continued).

Contaminant	Waste Stream Code	Percentage in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
	ARA-602-3H	1.2	1.60E+03	Hot Cell waste consisting of some fuel residue	Surface wash	6.00E+01	mL/g	Distribution coefficient	1% drums, 99% other
	ARA-602-1H	1.0	1.38E+03	Miscellaneous debris from SL-1 cleanup (e.g., 1,000-gal tank, demineralizer with resin, building materials, pipes, soil, wire, concrete, and insulation)	Surface wash	6.00E+01	mL/g	Distribution coefficient	No containment
	Miscellaneous[c]	6.1	8.55E+03	Mostly debris waste	—	—	—	—	—
Total Sr-90		**100.0**	**1.36E+05**						
Tc-99	ANL-MOD-1H	16.3	6.88E+00	Irradiated subassembly hardware (1977–1983)	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	9% drums, 91% other
	INTEC-MOD-2H	15.8	6.67E+00	Leached Vycor glass	Dissolution	1.30E-05	1/year	Vycor glass fractional corrosion rate	No containment
	ANL-MOD-1R	14.8	6.24E+00	Irradiated subassembly hardware (1984–1993)	Dissolution	1.19E-05	1/year	Stainless steel fractional corrosion rate	No containment
	TRA-603-1N	8.0	3.37E+00	Resins	Surface wash	1.90E+01	mL/g	Resins distribution coefficient	No containment
	TRA-632-2N	6.2	2.60E+00	Hot Cell waste	Surface wash	0.00E+00	mL/g	Distribution coefficient	24% drums, 76% other
	LLW—resins	4.8	2.05E+00	2000–2009 resins	Surface wash	1.90E+01	mL/g	Resins distribution coefficient	
	ANL-MOD-5H	4.0	1.70E+00	General plant waste, mostly from decontamination (1952–1983)	Surface wash	0.00E+00	mL/g	Distribution coefficient	6% drums, 94% other
	INTEC-MOD-9H	3.8	1.60E+00	General plant waste (e.g., metal, glass, paper, metal, wood, clothing, plastic, dirt, and shielding material) (1952–1983)	Surface wash	0.00E+00	mL/g	Distribution coefficient	2% drums, 98% other
	NRF-MOD-1H	3.5	1.49E+00	Shippingport fuel material, solid (1960–1968)	Dissolution	3.47E-02[d]	1/year	Nuclear fuels fractional corrosion rate	No containment
	TRA-603-28N	3.4	1.45E+00	Miscellaneous contaminated materials	Surface wash	0.00E+00	mL/g	Distribution coefficient	No containment
	NRF-MOD-10H	2.8	1.19E+00	Compactable and noncompactable waste from Expended Core Facility and prototype plant operations (1952–1983)	Surface wash	0.00E+00	mL/g	Distribution coefficient	7% drums, 93% other
	TRA-603-9N	2.2	9.30E-01	Fuel materials (solids, not dissolved)	Dissolution	3.47E-02[d]	1/year	Nuclear fuels fractional corrosion rate	8% drums, 92% other
	INTEC-MOD-5H	2.1	8.84E-01	HEPA filter from Waste Calcining Facility and other filters from miscellaneous facilities	Surface wash	0.00E+00	mL/g	Distribution coefficient	No containment
	INTEC-MOD-6H	1.9	8.20E-01	CPP-603 resins (i.e., basin sludge and miscellaneous storage basin Zeolite filters)	Surface wash	1.90E+01	mL/g	Resins distribution coefficient	No containment
	D&D-ARA-1	1.5	6.42E-01	Contaminated metal and debris from decontamination and demolition of Auxiliary Reactor Area facilities	Surface wash	0.00E+00	mL/g	Distribution coefficient	No containment
	ANL-MOD-2H	1.4	5.89E-01	Irradiated and unirradiated fuel specimens (1971–1983)	Dissolution	3.47E-02[d]	1/year	Nuclear fuels fractional corrosion rate	7% drums, 93% other
	INTEC-MOD-7H	1.3	5.51E-01	Contaminated soil from Tank Farm spills	Surface wash	0.00E+00	mL/g	Distribution coefficient	No containment
	ANL-MOD-3H	1.2	5.20E-01	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1952–1970)	Surface wash	0.00E+00	mL/g	Distribution coefficient	6% drums, 94% other

Table 4-2. (continued).

Contaminant	Waste Stream Code	Percentage in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
	ANL-MOD-2HEXT	1.2	4.90E-01	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1984–1993)	Surface wash	0.00E+00	mL/g	Distribution coefficient	No containment
	Miscellaneous[c]	3.8	1.59E+00	Various waste types	—	—	—	—	—
Total Tc-99		**100.0**	**4.23E+01**						
Th-228	ALE-317-2R	78.3	8.2E+00	Cloth, paper, wood, plastic, cut-up scrap, cut-up gloveboxes, and other general plant waste	Surface wash	—	mL/g	Distribution coefficient	No containment
	CEG-CEG-1R	19.1	2.0E+00	Powder solidified in Aquaset	Surface wash	—	mL/g	Distribution coefficient	No containment
	INTEC-MOD-9H	1.3	1.3E-01	General plant waste (e.g., metal, glass, paper, metal, wood, clothing, plastic, dirt, and shielding material) (1952–1983)	Surface wash	—	mL/g	Distribution coefficient	2% drums, 98% other
	Miscellaneous[c]	1.3	1.3E-01	Various waste types	Surface wash	—	mL/g	Distribution coefficient	—
Total Th-228		**100.0**	**1.05E+01**						
U-232	TRA-603-9N	79.0	8.36E+00	Fuel materials	Surface wash	—	mL/g	Distribution coefficient	8% drums, 92% other
	ALE-317-2R	20.9	2.21E+00	Cloth, paper, wood, plastic, cut-up scrap, cut-up gloveboxes, and other general plant waste	Surface wash	—	mL/g	Distribution coefficient	No containment
	Miscellaneous[c]	0.1	1.73E-02	Various waste types	Surface wash	—	mL/g	Distribution coefficient	—
Total U-232		**100.0**	**1.06E+01**						
U-233	TRA-603-9N	28.4	6.01E-01	Fuel materials	Surface wash	1.54E+01	mL/g	Distribution coefficient	8% drums, 92% other
	ARA-626-1H	28.4	6.00E-01	Some fuel scraps, waste from disassembly of facilities and Hot Cell waste	Surface wash	1.54E+01	mL/g	Distribution coefficient	2% drums, 98% other
	RFO-DOW-19H	25.5	5.40E-01	U-233	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums
	SMC-628-2	14.2	3.01E-01	Unsolidified slag	Surface wash	1.54E+01	mL/g	Distribution coefficient	11% drums, 89% other
	SMC-990-1	1.3	2.74E-02	Metals, glass, and gravel contaminated with depleted uranium	Surface wash	1.54E+01	mL/g	Distribution coefficient	66% drums, 34% other
	SMC-628-1	1.1	2.21E-02	Nonacidic evaporator sludge	Surface wash	1.54E+01	mL/g	Distribution coefficient	46% drums, 54% other
	Miscellaneous[c]	1.1	2.43E-02	Various waste types	—	—	—	—	—
Total U-233		**100.0**	**2.12E+00**						
U-234	RFO-DOW-18H	33.7	2.15E+01	Enriched uranium	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums and boxes
	RFO-DOW-16H	22.7	1.45E+01	Depleted uranium	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums
	PDA-RFO-1A	7.3	4.64E+00	Evaporator salt (nitrate) and roaster oxides (depleted uranium)	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums
	OFF-ATI-1H	5.7	3.64E+00	Irradiated fuel and chemical byproducts from nuclear research	Surface wash	1.54E+01	mL/g	Distribution coefficient	36% drums, 64% other
	OFF-GEC-1H	4.6	2.95E+00	Core, reactor vessel, and loop components	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	TAN-607-3N	3.6	2.33E+00	Activated core, loop components, end boxes, and stainless steel from SL-1 reactor	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment

Table 4-2. (continued).

Contaminant	Waste Stream Code	Percentage in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
	TAN-607-2	2.9	1.83E+00	TAN Hot Shop noncompactable waste	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	INTEC-MOD-6H	2.4	1.56E+00	CPP-603 resins (i.e., basin sludge and miscellaneous storage basin Zeolite filters)	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	OFF-CSM-1H	2.0	1.30E+00	Magnesium fluoride slag with 1% natural uranium, steel metallic salt and silicate, miscellaneous laboratory waste	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums
	ANL-MOD-2R	1.5	9.47E-01	Bulk actinide waste from the Zero Power Plutonium Reactor and other facilities	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	ANL-MOD-5H	1.3	8.41E-01	General plant waste, mostly from decontamination (1952–1983)	Surface wash	1.54E+01	mL/g	Distribution coefficient	6% drums, 94% other
	ANL-MOD-4H	1.2	7.48E-01	Low or unirradiated bulk-actinide waste	Surface wash	1.54E+01	mL/g	Distribution coefficient	25% drums, 75% other
	ALE-317-2R	1.1	7.10E-01	Cloth, paper, wood, plastic, cut-up scrap, cut-up gloveboxes, and other general plant waste	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	ARA-627-1H	1.0	6.38E-01	Plastic bags, brick, HEPA filters, scrap, gloveboxes, and fuel	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	Miscellaneous[c]	9.0	5.73E+00	Mostly scrap metal	—	—	—	—	—
Total U-234		**100.0**	**6.39E+01**						
U-235	RFO-DOW-16H	22.0	1.08E+00	Depleted uranium	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums
	INTEC-MOD-3H	19.3	9.47E-01	Unirradiated and irradiated fuel specimens from natural and depleted fuel mockups	Surface wash	1.54E+01	mL/g	Distribution coefficient	2% drums, 98% other
	RFO-DOW-18H	15.1	7.44E-01	Enriched uranium	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums and boxes
	TRA-603-9N	9.9	4.86E-01	Fuel materials (solids, not dissolved)	Surface wash	1.54E+01	mL/g	Distribution coefficient	8% drums, 92% other
	PDA-RFO-1A	6.6	3.25E-01	Evaporator salt (nitrate) and roaster oxides (depleted uranium)	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums
	WAG-WG7-02	3.7	1.80E-01	Acid Pit in situ stabilization treatability study	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	OFF-GEC-1H	3.2	1.57E-01	Core, reactor vessel, and loop components	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	OFF-ATI-1H	2.3	1.14E-01	Irradiated fuel and chemical byproducts from nuclear research	Surface wash	1.54E+01	mL/g	Distribution coefficient	36% drums, 64% other
	TAN-607-3N	1.6	8.00E-02	Activated core, loop components, end boxes, and stainless steel from SL-1 reactor.	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	OFF-CSM-1H	1.6	8.00E-02	Magnesium fluoride slag with 1% natural uranium, steel metallic salt and silicate, miscellaneous laboratory waste	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums
	OFF-GDA-1H	1.4	7.00E-02	Fuel fabrication items, laboratory equipment, activated metal, and irradiated fuel	Surface wash	1.54E+01	mL/g	Distribution coefficient	48% drums, 52% other

Table 4-2. (continued).

Contaminant	Waste Stream Code	Percentage in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
	INTEC-MOD-6H	1.1	5.38E-02	CPP-603 resins (i.e., basin sludge and miscellaneous storage basin Zeolite filters)	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	Miscellaneous[c]	12.2	5.98E-01	Mostly fuel-contaminated waste	—	—	—	—	—
Total U-235		**100.0**	**4.92E+00**						
U-236	RFO-DOW-16H	62.4	9.03E-01	Depleted uranium	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums
	TRA-632-2N	6.3	9.07E-02	Hot Cell waste	Surface wash	1.54E+01	mL/g	Distribution coefficient	24% drums, 76% other
	RFO-DOW-18H	5.6	8.04E-02	Enriched uranium	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums and boxes
	INTEC-MOD-3H	4.1	6.00E-02	Unirradiated and irradiated fuel specimens from natural and depleted fuel mockups	Surface wash	1.54E+01	mL/g	Distribution coefficient	2% drums, 98% other
	ANL-MOD-5H	3.7	5.42E-02	General plant waste, mostly from decontamination (1952–1983)	Surface wash	1.54E+01	mL/g	Distribution coefficient	6% drums, 94% other
	TRA-603-28N	3.5	5.05E-02	Miscellaneous contaminated materials	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	SMC-628-2	3.0	4.37E-02	Unsolidified slag	Surface wash	1.54E+01	mL/g	Distribution coefficient	11% drums, 89% other
	TRA-603-9N	2.3	3.28E-02	Fuel materials (solids, not dissolved)	Surface wash	1.54E+01	mL/g	Distribution coefficient	8% drums, 92% other
	ANL-MOD-2H	1.3	1.87E-02	Irradiated and unirradiated fuel specimens (1971–1983)	Surface wash	1.54E+01	mL/g	Distribution coefficient	7% drums, 93% other
	LLW—trash	1.2	1.75E-02	2000–2009 miscellaneous LLW	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	ANL-MOD-3H	1.1	1.66E-02	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1952–1970)	Surface wash	1.54E+01	mL/g	Distribution coefficient	6% drums, 94% other
	ANL-MOD-2HEXT	1.1	1.56E-02	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1984–1993)	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	Miscellaneous[c]	4.4	6.43E-02	Mostly fuel-contaminated waste	—	—	—	—	—
Total U-236		**100.0**	**1.45E+00**						
U-238	RFO-DOW-16H	51.3	7.62E+01	Depleted uranium (roaster oxide)	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums
	RFO-DOW-3H	18.8	2.79E+01	Uncemented sludge	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums
	PDA-RFO-1A	16.8	2.49E+01	Evaporator salt (nitrate) and roaster oxides (depleted uranium) on Pad A	Surface wash	1.54E+01	mL/g	Distribution coefficient	Drums
	LLW—trash	5.0	7.39E+00	2000–2009 miscellaneous LLW	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment
	SMC-628-2	1.5	2.31E+00	Unsolidified slag	Surface wash	1.54E+01	mL/g	Distribution coefficient	11% drums, 89% other
	ARA-627-1H	1.1	1.64E+00	Plastic bags, brick, HEPA filters, scrap, gloveboxes, and fuel	Surface wash	1.54E+01	mL/g	Distribution coefficient	No containment

Table 4-2. (continued).

Contaminant	Waste Stream Code	Percentage in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
	Miscellaneous[c]	5.5	8.14E+00	Mostly debris, some fuel-contaminated waste, and ingrowth from Rocky Flats Plant Pu-242	—	—	—	—	—
Total U-238		**100.0**	**1.48E+02**						

a. Estimates have not been adjusted for inventory removed by the Accelerated Retrieval Project.
b. See Section 4.4.
c. "Miscellaneous" indicates numerous waste streams that contribute less than 1% to the total. They are combined for the table but are explicitly included with the appropriate release mechanism in the release simulations.
d. The annual fractional release rate (1/year) determines the corrosion or dissolution rate. A value of 3.47E-02 1/year originally was calculated as an upper bound for fuel-like materials. However, the reference supporting these calculations is no longer available. Using an available reference, a new value was calculated at 3.15E-02 1/year. Because the original value was considered credible and is still more conservative than the new value, it was used in the modeling.

HEPA = high-efficiency particulate air
LLW = low-level waste
SL-1 = Stationary Low-Power Reactor No. 1
TAN = Test Area North

Table 4-3. Rocky Flats Plant plutonium-238, -239, and -240 waste streams, best-estimate inventories (curies) at time of disposal, and baseline source-release information for Operable Unit 7-13/14 modeling.

Contaminant	Waste Type	Portion in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description
Pu-238	Graphite	27.8	5.13E+02	Molds, crucibles, and scarfings	Surface wash	2.50E+03	mL/g	Distribution coefficient
	Type III	19.8	3.65E+02	Filters	Surface wash	2.50E+03	mL/g	Distribution coefficient
	Type I and V	18.6	3.43E+02	Debris	Surface wash	2.50E+03	mL/g	Distribution coefficient
	Line-generated waste	15.5	2.86E+02	Line-generated waste (e.g., gloves and gloveboxes)	Surface wash	2.50E+03	mL/g	Distribution coefficient
	Series 741	12.3	2.28E+02	Series 741 and 742 sludge (e.g., inorganic first- and second-stage sludge)	Surface wash	2.50E+03	mL/g	Distribution coefficient
	Type I	5.4	1.00E+02	Combustible materials (e.g., paper, rags, plastic, clothing, wood, and polyethylene bottles)	Surface wash	2.50E+03	mL/g	Distribution coefficient
	Series 744	0.3	5.61E+00	Series 744 sludge (special setups)	Surface wash	2.50E+03	mL/g	Distribution coefficient
	Series 743	0.3	4.85E+00	Series 743 sludge (organic)	Surface wash	2.50E+03	mL/g	Distribution coefficient
	Series 745	0.0	1.79E-01	Series 745 nitrate salt	Surface wash	2.50E+03	mL/g	Distribution coefficient
Total Rocky Flats Plant Pu-238		**100.0**	**1.85E+03**					
Pu-239	Graphite	26.5	1.67E+04	Molds, crucibles, and scarfings	Subdivided into two fractions (see below)			
	Type III	18.8	1.19E+04	Filters				
	Type I and V	17.7	1.12E+04	Debris				
	Line-generated waste	14.8	9.31E+03	Line-generated waste (e.g., gloves and gloveboxes)				
	Series 741	11.8	7.42E+03	Series 741 and 742 sludge (e.g., inorganic first- and second-stage sludge)				
	Type I	5.2	3.26E+03	Combustible materials (e.g., paper, rags, plastic, clothing, wood, and polyethylene bottles)				
	Type II	4.7	2.93E+03	Glass				
	Series 744	0.3	1.83E+02	Series 744 sludge (special setups)				
	Series 743	0.2	1.58E+02	Series 743 sludge (organic)				
	Series 745	0.0	5.82E+00	Series 745 nitrate salt				
Total Rocky Flats Plant Pu-239		**100.0**	**6.30E+04**					
	Fraction 0.037		2.33E+03	Simulated mobile fraction	Surface wash	0.00E+00	mL/g	Distribution coefficient
	Fraction 0.963		6.07E+04	Sorbing fraction	Surface wash	2.50E+03	mL/g	Distribution coefficient

Table 4-3. (continued).

Contaminant	Waste Type	Portion in Waste Stream (%)	Inventory (Ci)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description
Pu-240	Graphite	26.4	3.72E+03	Molds, crucibles, and scarfings	Subdivided into two fractions (see below)			
	Type III	18.8	2.64E+03	Filters				
	Type I and V	17.7	2.50E+03	Debris				
	Line-generated waste	14.8	2.09E+03	Line-generated waste (e.g., gloves and gloveboxes)				
	Series 741	11.8	1.66E+03	Series 741 and 742 sludge (e.g., inorganic first- and second-stage sludge)				
	Type I	5.2	7.29E+02	Combustible materials (e.g., paper, rags, plastic, clothing, wood, and polyethylene bottles)				
	Type II	4.7	6.57E+02	Glass				
	Series 744	0.3	4.09E+01	Series 744 sludge (special setups)				
	Series 743	0.3	3.54E+01	Series 743 sludge (organic)				
	Series 745	0.0	3.57E-01	Series 745 nitrate salt				
Total Rocky Flats Plant Pu-240		**100.0**	**1.41E+04**					
	Fraction 0.037		5.20E+02	Simulated mobile fraction	Surface wash	0.00E+00	mL/g	Distribution coefficient
	Fraction 0.963		1.35E+04	Sorbing fraction	Surface wash	2.50E+03	mL/g	Distribution coefficient

a. Estimates have not been adjusted for inventory removed by the Accelerated Retrieval Project.
b. See Section 4.4.

Table 4-4. Volatile organic compound waste streams, best-estimate inventories (grams) at time of disposal, and baseline source-release information for Operable Unit 7-13/14 modeling.

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (g)[a]	Waste Stream Description	Release Mechanism[b]	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
Carbon tetrachloride	RFO-DOW-15H	99.5	7.86E+08	Series 743 sludge (organic)	Diffusion	2.50E-06	cm^2/second	Diffusion rate	Drums
	Miscellaneous	0.5	3.66E+06	Mostly other Rocky Flats Plant waste					Mixed drums and boxes
Total carbon tetrachloride		**100.0**	**7.90E+08**						
Methylene chloride	RFO-DOW-3H	51.2	7.21E+06	Uncemented sludge	Diffusion	2.50E-06	cm^2/second	Diffusion rate	99.8% drums, 0.2% wooden boxes
	RFO-DOW-4H	20.3	2.85E+06	Equipment (e.g., drill presses, lathes, and pumps)	Diffusion	2.50E-06	cm^2/second	Diffusion rate	70% drums, 30% wooden boxes
	RFO-DOW-9H	18.3	2.58E+06	Paper, rags, and plastic	Diffusion	2.50E-06	cm^2/second	Diffusion rate	55% drums, 45% wooden boxes
	RFO-DOW-12H	9.3	1.31E+06	Dirt, sand, concrete, ashes, and soot	Diffusion	2.50E-06	cm^2/second	Diffusion rate	81% drums, 19% wooden boxes
	RFO-DOW-6H	0.9	1.36E+05	Filters	Diffusion	2.50E-06	cm^2/second	Diffusion rate	Wooden or cardboard boxes
Total methylene chloride		**100.0**	**1.41E+07**						
Tetrachloroethylene	RFO-DOW-15H	100.0	9.87E+07	Series 743 sludge (organic)	Diffusion	2.00E-06	cm^2/second	Diffusion rate	Drums
Total tetrachloroethylene		**100.0**	**9.87E+07**						
Trichloroethylene	RFO-DOW-15H	99.6	9.68E+07	Series 743 sludge (organic)	Diffusion	2.00E-06	cm^2/second	Diffusion rate	Drums
	Miscellaneous	0.4	4.07E+05	PER waste streams	Diffusion	2.00E-06	cm^2/second	Diffusion rate	
Total trichloroethylene		**100.0**	**9.72E+07**						
1,4-Dioxane	RFO-DOW-15H	88.2	1.72E+06	Series 743 sludge (organic)	Diffusion	2.50E-06	cm^2/s	Diffusion rate	Drums
	RFO-DOW-4H	7.8	1.52E+05	Equipment (drill presses, lathes, and pumps)	Diffusion	2.50E-06	cm^2/s	Diffusion rate	70% drums, 30% wooden boxes
	CPP-603-4H	1.9	3.62E+4	Rags	Diffusion	2.50E-06	cm^2/s	Diffusion rate	Fiber boxes
	Miscellaneous	2.1	4.24E+04	Mostly combustible waste	Diffusion	2.50E-06	cm^2/s	Diffusion rate	
Total 1,4-Dioxane		**100.0**	**1.95E+06**						

a. Estimates were not adjusted for inventory removed by the Accelerated Retrieval Project.
b. See Section 4.4.

Table 4-5. Nitrate and chromium waste streams, best-estimate inventories (grams) at time of disposal, and baseline source-release information for Operable Unit 7-13/14 modeling.

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (g)	Waste Stream Description	Release Mechanism	Release Parameter Value	Release Parameter Units	Parameter Description	Container Type
Nitrate (as nitrogen)	PDA-RFO-1A	51.6	2.35E+08	Evaporator salts	Surface wash	0.00E+00	mL/g	Distribution coefficient	54.8% drums, 45.2% boxes
	RFO-DOW-17H	37.5	1.71E+08	Evaporator salts	Surface wash	0.00E+00	mL/g	Distribution coefficient	Drums
	CPP-601-4H	10.8	4.95E+07	Aqueous chemicals	Surface wash	0.00E+00	mL/g	Distribution coefficient	No container
	Miscellaneous	0.1	2.57E+05						
Total nitrate (as nitrogen)		**100.0**	**4.56E+08**						
Chromium	PDA-RFO-1A	78.6	1.82E+06	Evaporator salts	Surface wash	1.00E-01	mL/g	Distribution coefficient	54.8% drums, 45.2% boxes
	RFO-DOW-17H	21.4	4.96E+05	Evaporator salts	Surface wash	1.00E-01	mL/g	Distribution coefficient	Drums
	Miscellaneous	0.0	1.05E+03						
Total chromium		**100.0**	**2.32E+06**						

Table 4-6. Activity of radionuclides (Groups 1 through 6 and 9) in Pit 4 before and after the Accelerated Retrieval Project retrieval.

Group	Radionuclide	Immediately Before Retrieval (2004) (Ci)	Immediately After Retrieval (2004) (Ci)
1	Am-241	4.83E+04	3.32E+04
	Np-237	6.04E-01	6.04E-01
	U-233	4.90E-05	4.90E-05
	Th-229	5.78E-08	5.78E-08
2	Am-243	1.76E-05	1.76E-05
	Pu-239 (mobile/colloidal)	1.26E+02	9.24E+01
	Pu-239	1.26E+04	9.23E+03
	U-235	2.90E-01	2.90E-01
	Pa-231	2.16E-04	2.16E-04
	Ac-227	8.99E-05	8.99E-05
3	Pu-240 (mobile/colloidal)	2.73E+01	2.08E+01
	Pu-240	2.87E+03	2.19E+03
	U-236	1.21E-01	1.21E-01
	Th-232	2.25E-01	2.25E-01
	Ra-228	2.10E-01	2.10E-01
4	Pu-238[a]	2.85E+02	2.12E+02
5	U-238	2.63E+01	1.43E+01
	U-234	3.94E+00	2.12E+00
	Th-230	1.38E-03	1.38E-03
	Ra-226	2.66E+00	2.66E+00
	Pb-210	1.90E+00	1.90E+00
6	Tc-99[b]	2.06E-03	2.06E-03
	I-129[b]	4.33E-06	4.33E-06
	Cl-36[b]	1.72E-12	1.72E-12
	Tc-99[c]	0.00E+00	0.00E+00
	I-129[c]	0.00E+00	0.00E+00
	Cl-36[c]	0.00E+00	0.00E+00
	Tc-99[d]	2.89E-04	2.89E-04
	I-129[d]	0.00E+00	0.00E+00
	Cl-36[d]	0.00E+00	0.00E+00
	Tc-99[e]	8.81E-06	8.81E-06
	I-129[e]	3.48E-08	3.48E-08
	Cl-36[e]	0.00E+00	0.00E+00
	Tc-99[f]	0.00E+00	0.00E+00
	I-129[f]	0.00E+00	0.00E+00
	Cl-36[f]	0.00E+00	0.00E+00
	Tc-99[g]	7.77E-04	7.77E-04
	I-129[g]	1.40E-06	1.40E-06
	Cl-36[g]	8.97E-07	8.97E-07

Table 4-6. (continued).

Group	Radionuclide	Immediately Before Retrieval (2004) (Ci)	Immediately After Retrieval (2004) (Ci)
9	Nb-94	8.21E-05	8.21E-05
	Sr-90	2.09E+02	2.09E+02

a. Inventories for Group 4 daughter products (i.e., U-234, Th-230, Ra-226, and Pb-210) are included in Group 5.
b. Associated with activated metal (called C-14A in the model).
c. Associated with beryllium blocks (called C-14B in the model).
d. Associated with fuel-like materials (called C-14F in the model).
e. Associated with resins (called C-14R in the model).
f. Associated with Vycor glass (called C-14V in the model).
g. Subject to surface wash (called C-14W in the model).

Table 4-7. Mass of volatile organic compounds and nonradionuclides (Groups 10 and 11) in the Pit 4 retrieval area before and after the Accelerated Retrieval Project.

Group	Contaminant	Immediately Before Retrieval (g)	Immediately After Retrieval (g)
10	Nitrate	4.49E+06	4.49E+06
	Chromium	1.12E+04	1.12E+04
11	Carbon tetrachloride	4.40E+07	8.80E+06
	Methylene chloride	6.31E+05	6.31E+05
	Tetrachloroethylene	5.52E+06	1.10E+06
	Trichloroethylene	NA[a]	NA[a]
	1,4-Dioxane	3.96E+04	8.37E+03

a. Simulations for trichloroethylene will be part of the feasibility study; value not yet computed.

- Rocky Flats Plant adjustments in the tables include the following:
  - Reductions for retrievals in Pits 11 and 12
  - Corrections based on assay data (McKenzie et al. 2005)
  - Revised distributions of plutonium among pre-1964 Rocky Flats Plant waste streams—Table 4-3 shows the distribution of Rocky Flats Plant plutonium by waste type based on the evaluation by Zodtner and Rogers (1964). These data match the curie values presented in the Historical Data Task but provide a different breakdown by waste stream.
  - Assumed colloidal fraction—Based on analysis by Batcheller and Redden (2004), approximately 3.7% of all Rocky Flats Plant Pu-239 and -240 is assumed to be colloids and is simulated as a mobile fraction (zero partitioning to the soil), while the remaining 96.3% is sorbs to the soil.
  - Corrections to original volatile organic compound (VOC) inventories based on Miller and Varvel (2005) as modified to apply rounding protocols consistent with other inventory estimates (e.g., round to the second decimal place).

- The Cl-36 inventory reported in the Historical Data Task as waste stream OFF-UBM-1H was revised from 3.14E-01 Ci to 5.00E-06 Ci based on reevaluation of waste received from the U.S. Bureau of Mines, reducing the total Cl-36 source term from 1.97 Ci to 1.66 Ci (McKenzie et al. 2005).

- Inventory estimates for the Materials and Fuels Complex, Idaho Nuclear Technology and Engineering Center, Naval Reactors Facility, Test Area North, and Reactor Technology Complex were taken from the respective inventory reports. Some additional adjustments were identified during validation of WILD. These adjustments were documented by McKenzie et al. 2005.

- The non-time-critical removal action implemented to grout beryllium blocks does not generate a change in source-term inventory. Effects of the removal action will be simulated by reducing the release rate associated with the grouted beryllium block waste form.

- Revised inventory estimates in Tables 4-2 and 4-3 show waste streams that contribute at least 1% of the total contaminant inventory at the time of disposal. Remainders are shown as "Miscellaneous" to constrain the sizes of the tables. However, all waste streams, regardless of relative contribution, are modeled. Most miscellaneous waste steams are of only minor interest.

- Most distribution coefficients in Tables 4-2, 4-3, and 4-8 are listed in Appendix A of the Second Addendum (Table A-4) (Holdren Broomfield 2004). Adjustments include correcting values for C-14 and chromium and adding values for C-14, I-129, and Tc-99 in resins.

- Four dissolution rates appear in Table 4-2 based on waste form: beryllium waste, fuel-contaminated waste, Vycor glass, and activated metal components. Variable rates within waste forms are not applied. For example, dissolution of activated metal components is simulated using a fractional release rate of 1.19E-05/yr. This rate best represents stainless steel but also is used to represent more corrosion-resistant metal such as zircaloy and inconel.

- Inventories reported in the Ancillary Basis for Risk Analysis (ABRA) (Holdren et al. 2002) for nitrate were upper-bound estimates and should have been best estimates. Table 4-5 shows the correct best-estimate values used to assess nitrate as nitrogen. Mass estimates were developed by applying conversion factors for nitrogen-bearing compounds to nitrogen mass. A similar process was followed for chromium. These conversion factors and their derivation are described in Appendix A.

- The inventories used in the modeling are data retrieved from WILD on October 1, 2004. The WILD is currently undergoing validation; therefore, there could be some differences in the inventory and distribution currently in WILD compared to the values used in the modeling. Any changes to the inventory developed as part of the validation process are expected to be minor and not impact the total risk estimates.

- The inventories of U-238 and Am-241 from the Rocky Flats Plant were increased based on assay data of Rocky Flats Plant waste retrieved from Transuranic Storage Area pads.

- The base case accounts for the grouting of the beryllium blocks and the Accelerated Retrieval Project retrieval. To simplify the modeling, both actions are assumed to occur in the year 2004 in the simulations. The grouting did occur in 2004, and the Accelerated Retrieval Project retrieval started early in 2005.

Table 4-9 highlights the difference in inventory from that used in the ABRA. Tables 4-10 and 4-11 provide the inventory by waste generator. Tables 4-6 and 4-7 show the mass assumed removed by the Accelerated Retrieval Project retrieval in Pit 4.

Table 4-8. Distribution coefficients (K_d).

Contaminant	Ancillary Basis for Risk Analysis (cm^3/g or mL/g)	Remedial Investigation and Baseline Risk Assessment and Feasibility Study[a] (cm^3/g or mL/g)
Ac-227	4.00E+02	2.25E+02[b]
Am-241	4.50E+02	2.25E+02[b]
Am-243	4.50E+02	2.25E+02[b]
C-14 (surface wash)	1.00E-01	4.00E-01[c]
C-14 (resins)	1.00E-01	1.90E+01[d]
Cl-36	0.00E+00	0.00E+00
I-129	1.00E-01	0.00E+00[e]
Nb-94	5.00E+02	5.00E+02
Np-237	8.00E+00	2.30E+01[f]
Pa-231	8.00E+00	8.00E+00
Pb-210	2.70E+02	2.70E+02
Pu-238	5.10E+03	2.50E+03[b]
Pu-239	5.10E+03	0.00E+00[g] and 2.50E+03[b,h,i]
Pu-240	5.10E+03	0.00E+00[g] and 2.50E+03[b,h,i]
Ra-226	5.75E+02	5.75E+02
Ra-228	NA[j]	5.75E+02[k]
Sr-90	6.00E+01	6.00E+01
Tc-99 (surface wash)	0.00E+00	0.00E+00
Tc-99 (resins)	0.00E+-01	1.90E+01[d]
Th-228	5.00E+02	5.00E+02
Th-229	5.00E+02	5.00E+02
Th-230	5.00E+02	5.00E+02
Th-232	5.00E+02	5.00E+02
U-232	6.00E+00	1.54E+01[e]
U-233	6.00E+00	1.54E+01[e]
U-234	6.00E+00	1.54E+01[e]
U-235	6.00E+00	1.54E+01[e]
U-236	6.00E+00	1.54E+01[e]
U-238	6.00E+00	1.54E+01[e]
Chromium	NA[j]	1.00E-01[m]
Nitrate	0.00E+00	0.00E+00
Carbon tetrachloride	NA[j]	0.00E+00[n]

Table 4-8. (continued).

Contaminant	Ancillary Basis for Risk Analysis (cm³/g or mL/g)	Remedial Investigation and Baseline Risk Assessment and Feasibility Study[a] (cm³/g or mL/g)
Methylene chloride	NA[j]	0.00E+00[n]
Tetrachloroethylene	NA[j]	0.00E+00[n]
Trichloroethylene[p]	NA[j]	0.00E+00[n]
1,4-Dioxane	NA[j]	0.00E+00[n]

a. Green shading indicates a change compared to the value used in the Ancillary Basis for Risk Analysis.
b. Based on sieving of interbed material (Hull 2003).
c. Plummer et al. (2004) suggests a lower bound of 0.5 ± 0.1 mL/g, so 0.4 is used.
d. Hull (2004).
e. Riley and Lo Presti (2004).
f. Leecaster and Hull (2004).
g. Mobile fraction source release, surficial sediment, and A-B interbed.
h. Mobile fraction in B-C and C-D interbeds.
i. Nonmobile fraction source release, surface sediment, and interbeds.
j. Contaminant was not modeled in the Ancillary Basis for Risk Analysis.
k. Same as Ra-226.
m. Becker et al. (1998).
n. For source-release modeling (DUST-MS). Release is diffusion-controlled, so K_d is not used.
p. Simulations for trichloroethylene will be part of the feasibility study; value not yet computed.

Table 4-9. Inventory modifications since the Ancillary Basis for Risk Analysis.

Isotope	RI/FS Curies	ABRA Total Curies	Reason for Change
Am-241	2.30E+05	1.83E+05	Stored Waste Examination Pilot Plant assay data evaluation
Am-243	1.17E-01	1.34E+02	Idaho National Laboratory Site waste evaluation
C-14	7.31E+02	5.00E+02	Idaho National Laboratory Site waste evaluation
Cl-36	1.66E+00	1.11E+00	Inclusion of generation by activation
Cs-137	1.73E+05	6.17E+05	Idaho National Laboratory Site waste evaluation
I-129	1.88E-01	1.58E-01	Idaho National Laboratory Site waste evaluation
Nb-94	1.46E+02	1.00E+03	Idaho National Laboratory Site waste evaluation
Np-237	1.41E-01	2.64E+00	Idaho National Laboratory Site waste evaluation
Pb-210	9.66E-06	5.10E-07	Idaho National Laboratory Site waste evaluation
Pu-238	2.08E+03	1.71E+04	Idaho National Laboratory Site waste evaluation
Pu-239	6.41E+04	6.49E+04	Idaho National Laboratory Site waste evaluation
Pu-240	1.46E+04	1.71E+04	Idaho National Laboratory Site waste evaluation
Pu-241	9.74E+05	3.81E+05	Idaho National Laboratory Site waste evaluation
Pu-242	2.34E+00	8.59E-01	Idaho National Laboratory Site waste evaluation
Ra-226	6.73E+01	6.00E+01	Idaho National Laboratory Site waste evaluation
Sr-90	1.36E+05	6.44E+05	Idaho National Laboratory Site waste evaluation

Table 4-9. (continued).

Isotope	RI/FS Curies	ABRA Total Curies	Reason for Change
Tc-99	4.23E+01	6.05E+01	Idaho National Laboratory Site waste evaluation
Th-228	1.56E+01	1.05E+01	Idaho National Laboratory Site waste evaluation
Th-230	5.77E-02	3.13E-02	Idaho National Laboratory Site waste evaluation
Th-232	3.48E+00	1.34E+00	Idaho National Laboratory Site waste evaluation
U-233	2.12E+00	1.51E+00	Idaho National Laboratory Site waste evaluation
U-232	1.37E+01	1.06E+01	Idaho National Laboratory Site waste evaluation
U-234	6.39E+01	6.74E+01	Idaho National Laboratory Site waste evaluation
U-235	4.92E+00	5.54E+00	Idaho National Laboratory Site waste evaluation
U236	1.45E+00	2.86E+00	Idaho National Laboratory Site waste evaluation
U-238	1.48E+02	1.17E+02	Stored Waste Examination Pilot Plant assay data evaluation

ABRA = Ancillary Basis for Risk Analysis (Holdren et al. 2002)
RI/FS = remedial investigation and feasibility study

Table 4-10. Summary by waste generator of best-estimate radionuclide source-term inventories (curies) at time of disposal for Operable Unit 7-13/14 modeling.

Radionuclide	MFC	INTEC	NRF	RFP[a]	TAN	RTC	Others	Totals 1952–1999	LLW 2000–2009	Grand Total
Am-241	3.05E+00	4.93E+00	1.19E+01	2.30E+05	1.30E+00	2.42E+00	3.31E-01	2.30E+05	4.44E-01	2.30E+05
Am-243	9.23E-06	4.33E-02	—	—	7.59E-04	7.10E-02	5.31E-06	1.15E-01	1.88E-03	1.17E-01
C-14	3.86E+01	2.57E+00	7.34E+01	—	1.70E-03	5.31E+02	1.04E+00	6.47E+02	8.46E+01	7.31E+02
Cl-36	7.98E-03	1.41E-03	2.16E-01	—	1.06E-02	8.83E-01	5.00E-06	1.12E+00	5.38E-01	1.66E+00
Cs-137	2.79E+04	6.70E+04	1.15E+04	1.31E+02	4.71E+03	3.48E+04	2.62E+04	1.72E+05	3.04E+02	1.73E+05
I-129	8.57E-03	2.45E-02	9.21E-03	—	1.26E-03	9.28E-02	2.13E-03	1.38E-01	4.92E-02	1.88E-01
Nb-94	5.65E+00	5.87E-01	3.17E+01	—	1.32E-02	9.39E+01	2.00E+00	1.34E+02	1.18E+01	1.46E+02
Np-237	3.43E-02	6.86E-03	4.39E-03	—	2.90E-03	6.88E-02	1.19E-03	1.18E-01	2.28E-02	1.41E-01
Pb-210	9.10E-06	4.25E-08	—	—	5.84E-09	1.06E-09	5.09E-07	9.66E-06	—	9.66E-06
Pu-238	1.15E+01	7.04E+01	1.89E+01	1.85E+03	2.55E+00	1.30E+02	2.16E-01	2.08E+03	4.91E-01	2.08E+03
Pu-239	5.12E+02	6.19E+00	4.68E+01	6.30E+04	1.45E+01	4.40E+00	5.01E+02	6.41E+04	5.07E-01	6.41E+04
Pu-240	7.07E+00	9.26E-01	4.07E+01	1.41E+04	3.83E+00	8.22E-01	4.50E+02	1.46E+04	1.83E-01	1.46E+04
Pu-241	1.23E+02	1.05E+02	3.21E+03	3.77E+05	1.97E+02	1.53E+02	4.84E-01	3.81E+05	2.23E+01	3.81E+05
Pu-242	1.94E-03	1.85E-03	—	8.48E-01	4.31E-04	5.77E-03	1.46E-05	8.58E-01	3.42E-04	8.59E-01
Ra-226	2.29E+00	1.75E-04	—	1.69E-01	5.05E-03	2.25E-10	6.46E+01	6.71E+01	1.19E-01	6.73E+01
Sr-90	2.01E+04	6.31E+04	6.94E+03	—	4.44E+03	3.34E+04	8.22E+03	1.36E+05	1.09E+02	1.36E+05
Tc-99	1.65E+01	1.10E+01	2.88E+00	—	7.19E-01	8.45E+00	6.43E-01	4.02E+01	2.09E+00	4.23E+01
Th-228	8.20E+00	2.65E-01	—	—	7.66E-03	1.45E-03	2.00E+00	1.05E+01	1.18E-03	1.05E+01
Th-230	2.02E-07	9.55E-05	—	—	2.50E-03	1.59E-07	2.89E-02	3.15E-02	2.89E-02	5.77E-02
Th-232	1.27E-03	1.15E-02	—	—	1.60E-02	2.10E+00	1.32E+00	3.45E+00	2.75E-02	3.48E+00
U-232	2.21E+00	8.86E-04	—	1.24E-02	4.88E-03	8.37E+00	3.51E-04	1.06E+01	5.41E-03	1.06E+01
U-233	5.69E-04	2.16E-04	4.26E-04	5.40E-01	3.50E-01	6.01E-01	6.05E-01	2.10E+00	1.74E-02	2.12E+00
U-234	3.37E+00	2.44E+00	8.44E-02	4.07E+01	6.58E+00	8.33E-02	1.02E+01	6.35E+01	4.07E-01	6.39E+01

Table 4-10. (continued).

Radionuclide	MFC	INTEC	NRF	RFP[a]	TAN	RTC	Others	Totals 1952–1999	LLW 2000–2009	Grand Total
U-235	1.49E-01	1.02E+00	1.66E-03	2.15E+00	2.23E-01	5.25E-01	8.13E-01	4.88E+00	3.82E-02	4.92E+00
U-236	1.08E-01	7.36E-02	1.20E-02	9.83E-01	7.38E-02	1.76E-01	3.67E-03	1.43E+00	1.75E-02	1.45E+00
U-238	1.39E+00	3.40E-01	8.33E-02	1.29E+02	3.54E+00	4.52E-02	6.69E+00	1.41E+02	7.39E+00	1.48E+02

a. Estimates have not been adjusted for inventory removed by the Accelerated Retrieval Project.

INTEC = Idaho Nuclear Technology and Engineering Center
LLW = Low-Level Waste Pit
MFC = Materials and Fuels Complex
NRF = Naval Reactors Facility
RFP = Rocky Flats Plant
RTC = Reactor Technology Complex
TAN = Test Area North

Table 4-11. Summary by waste generator of best-estimate inventories (grams) of selected chemicals buried for Operable Unit 7-13/14 modeling.

Chemical	Rocky Flats Plant	Other	Total
Carbon tetrachloride	7.86E+08	3.66E+06	7.90E+08
Chromium	2.32E+06	1.05E+03	2.32E+06
Methylene chloride	1.41E+07	—	1.41E+07
Nitrate	4.06E+08	4.98E+07	4.56E+08
Tetrachloroethylene[a]	9.87E+07	—	9.87E+07
Trichloroethylene	9.68E+07	4.07E+05	9.72E+07
1,4-Dioxane	1.91E+06	4.09E+04	1.95E+06

a. Tetrachloroethylene is also known as perchloroethylene.

4.3 Container Failure

The conceptual site model provides that no contaminants are released until the container fails. Waste was buried in the SDA in a multitude of containers. Container types include no containers, polyethylene bags, glass bottles, cardboard boxes, drums, wooden boxes, concrete casks, welded stainless steel containers, and resin tanks. To simplify the modeling, the container types were assessed and conservative estimates of the time to failure of the containers were used.

The majority of containers buried in the SDA were 55-gal metal drums. These drums provide a barrier to contaminant release until the metal corrodes. Historical disposal practices included periods when drums were carefully stacked in the SDA and periods when drums were dumped. Stacked drums are assumed to fail at a slower rate compared to drums that were dumped into the pits without attempting to maintain their integrity. On average, dumped drums are assumed to fail faster not because they fail upon emplacement, but because the metal gets creased or bent and the paint flakes off, providing ideal spots for corrosion to start. Also, drums stacked on their sides do not allow water to accumulate or pond; conversely, a dumped drum may provide a place for water to pond if it ends up in an upright or semi-upright position. The water could accelerate corrosion. A study was performed to determine the failure rate of metal drums in the SDA using data gathered during earlier waste-retrieval efforts (Becker 1997). Failure-rate distributions were developed to represent stacked and dumped drums. For stacked drums, a normal distribution with a mean failure time of 22.6 years from the time of disposal and a standard deviation of 9.7 years was used. For dumped drums, the data indicated that 28.5% fail at disposal and that the remaining 71.5% fail in a normal distribution, with a mean failure time of 11.7 years from time of disposal and a standard deviation of 5 years. The fraction of a contaminant disposed in drums was modeled with the distributed failure appropriate for the type of drum disposal, whether the drums were stacked or dumped.

Distributions to represent failure rates as a function of time for different types of containers, such as drums, concrete casks, and metal boxes, were developed (Becker et al. 1996; Becker 1997) and implemented in the source-term model. Multiple failure rates were assigned to contaminants buried in more than one type of container. For example, if the annual disposal inventory for a particular contaminant included disposals in both drums and cardboard boxes, the relative fraction for each container type was used to model the disposal for that year. For waste streams that were not buried in containers or that were buried in cardboard or wooden boxes, the container-failure time in the model was set at zero.

The rate of corrosion for carbon steel was used to determine the failure time of metal boxes and canisters. Boxes and canisters were considered to fail when one-half of the wall thickness had corroded. Both were treated as steel drums.

Each waste stream was evaluated for the type of container used. The disposal contents of many waste streams were buried in wood or other readily degradable boxes, and no delay of the contaminant release was assumed for the boxes in the model. Polyethylene bags were not accounted for in the container-failure modeling. The 55-gal drums, concrete casks, and metal boxes offer a barrier to contaminant release, which was accounted for in the source-term model. Waste streams listed as “O” (i.e., other) in Contaminant Inventory Database for Risk Assessment (Little et al. 2001), or as a combination of container types without a fractional distribution for each type, were modeled as having no container.

Container-failure assumptions for VOC drums were adjusted in response to an estimate of the VOC mass that remains in the pits (Sondrup et al. 2004). A longer mean-time-to-failure was used for VOC drums not only to match the estimates by Sondrup et al., but also because observations during the

Operable Unit (OU) 7-10 Glovebox Excavator Method Project (DOE-ID 2004) suggested polyethylene bags were a more significant barrier to VOC release than previously thought.

Container-failure assumptions for VOC drums were adjusted in response to the readily available probing results from Pit 4. Table 4-12 provides assumptions. Such a pseudo-calibration was not possible for the drums that did not contain VOCs (Sondrup et al. 2004).

Table 4-12. Container-failure assumptions.

Container	Modeled as	Mean Time to Failure (years)	Standard Deviation (years)	Initial Drum-failure Fraction
None, wood boxes, cardboard boxes, other	No container	NA	NA	0.0
Stacked drums	Gaussian failure	34.1	14.6	0.0
Dumped drums	Gaussian failure	11.7	5.0	0.285
Volatile organic compound drums	Gaussian failure	45.0	22.5	0.3

NA = not applicable.

4.4 Waste Forms and Release Mechanisms

When the containers fail, the contaminants can be released over time by one of three release mechanisms: surface wash, diffusion, or dissolution. The type of release mechanism and the release rates depend on the characteristics of the waste form. These release mechanisms are described as follows:

- **Surface Wash:** Radionuclides on the waste are partitioned into and carried downward into the vadose zone by infiltrating water. This model was applied to the general laboratory trash waste forms.

- **Diffusion:** Radionuclides and chemicals that are encased in a waste form may diffuse to the surface of the waste form where surface-wash mechanisms predominate. This model was applied to sludge and grouted or concrete-encased waste forms.

- **Dissolution:** This release mechanism covers the dissolution of materials containing radionuclides, where radionuclides are part of the material matrix. This model was applied to activated metals.

Yearly disposal amounts of each contaminant were proportioned among the three DUST-MS release mechanisms. The percentage of contaminant in a release mechanism was input into the DUST-MS code. Total disposed inventory was analyzed to determine the release mechanism and release rate as a function of the waste stream contents buried in any given year. Tables 4-2, 4-3, 4-4, and 4-5 contain summary information on the waste streams for each individual contaminant, a brief description of the waste streams, and the release mechanisms identified to model the waste streams.

Because each contaminant has a unique set of information, the disposal amount each year for each contaminant was modeled as a separate waste container. The DUST-MS code was used to compute the sum of the results to provide the total release over the time interval for input into the transport models. The basis for using the individual values is discussed in the following sections.

4.4.1 Activated Metal Waste Forms

Metal in a reactor is subject to bombardment by neutrons. When the neutrons interact with the metal atoms and change the isotope, it is called activation. Often the trace impurities in the metal are of greatest concern from a risk assessment standpoint. For example, through a series of reactions, the nitrogen impurity in steel becomes C-14 within the metal. Because the activation products are within the metal, they are not released until the metal corrodes. Several studies have been performed to determine the appropriate corrosion rate to use to calculate the release of contaminants from activated metal.

Nagata and Banaee (1996) assessed the metal buried in the SDA and concluded that the majority is a form of stainless steel or inconel (nickel-based alloy). Adler Flitton et al. (2001) provided a corrosion rate of 1 mm (0.039 in.) in 4,500 years (2.22E-05 cm/year) for stainless steel in soil for the INL Site with a magnesium chloride dust suppressant applied. For beryllium, the corrosion rate is based on results of a long-term corrosion and degradation test (Adler Flitton et al. 2001). The measured results from the test were modified to include the effect of the magnesium chloride dust suppressant that was applied to the surface of the SDA. The chloride in the dust suppressant would increase the corrosion rate of the beryllium metal. The beryllium corrosion rate is different from that used in the IRA.

4.4.2 Actinide Waste Streams

Actinides are heavy metals with an atomic number of 90 or greater. The actinides of major concern at the SDA are uranium and plutonium. The bulk of the waste containing uranium and plutonium comes from weapons production at the Rocky Flats Plant. The remainder comes from reactor research and operations at the INL Site. Most of the actinide waste is modeled as surface wash with a solubility limit. In general, the total chemical solubility is applied to each isotope. This is conservative because it allows more to be released than would actually occur. There are two major exceptions to this general procedure. For Pu-239 and Pu-240, a colloidal fraction of 3.7% is simulated. This fraction is based on Batcheller and Redden (2004) and is released as soon as the containment for the waste fails. The colloidal plutonium is modeled as being highly mobile and not solubility limited. The other major exception is for the major isotopes of uranium. Field measurements have shown that the release of uranium is solubility limited. The mass of uranium is dominated by one isotope. If the other isotopes were released at the total solubility limit for uranium, the risk from these isotopes would be greatly overpredicted. Therefore, for U-234, U-235, and U-238, the relative amount of mass disposed of was used to scale the total solubility to develop a solubility limit for the individual isotopes. This scaling is necessary because the source-release code DUST-MS does not allow coupling between source simulations to allow the solubility for each isotope to be computed during the simulation. The other uranium isotopes were simulated using the total solubility limit for uranium. In part, this was because these other isotopes would have more ingrowth; therefore, the solubility limit would change greatly as a function of time. While using the total solubility will greatly overestimate the release and subsequent risk from these isotopes, the predicted risk value is still below risk threshold and does not impact the total risk results.

4.4.3 Fission Product Waste Streams

Fission product waste is generated by reactor operations. Some of the inventory will be internal to fuel test specimens, some of it will be in the resins used to filter the reactor coolant, and some of it will be surface contamination waste from glovebox work. Each waste stream is identified and the appropriate release mechanism applied to the inventory. Some contaminants such as Tc-99 or C-14 can be generated by both activation and fission. Because of the multiple waste types for both fission and activation products, six separate release types are simulated. These are:

- Activated stainless steel—This waste type is irradiated stainless steel used in reactor components that have contaminants internal to the metal. The contaminants are released as the stainless steel corrodes.
- Activated beryllium—This waste type is large pieces of beryllium used in a reactor to reflect neutrons back into the core. Like the stainless steel, the contamination is internal to the metal. The contaminants are released through corrosion of the beryllium. The beryllium corrosion rate is higher than the stainless steel corrosion rate.
- Vycor glass—This waste type was generated at the INL Site when reactor fuel was reprocessed. The new fuel pins were formed in the Vycor glass. Some of the fuel residue was melted into the glass and discarded with the glass waste. The glass was acid-leached before disposal; therefore, the residual is not readily released. The release from the glass is assumed to be dissolution, with rates of dissolution derived from literature review.
- Surface wash—This waste type consists of materials with surface contamination that is readily leached by infiltrating water. The release of contaminants is controlled by partitioning between the waste form and water. Waste-to-water distribution coefficients are not known; therefore, soil-to-water distribution coefficients are used to simulate the release.
- Resins—This waste type consists of ion-exchange resins, which are used to purify the reactor cooling water. Contaminants are partitioned onto the resins and release with a separate waste-to-water distribution coefficient.
- Fuel test specimens—This waste type is generated by INL Site reactor operations. The contaminants are an integral part of the fuel and are released as the fuel material corrodes. The fuel corrosion rate is higher than either the stainless steel or beryllium corrosion rates.

These separate release simulations are summed to provide the total release of the contaminant. The release rates for each of these waste forms are provided in Section 4.7.

4.5 Source Discretization

For all of the radionuclides except C-14, the SDA was divided into 18 source areas. Figure 4-1 shows the 18 source areas. This has an additional five areas from what was used in the ABRA to better define where the INL Site fission and activation product waste was buried. For C-14, the ABRA had shown a large contribution to the risk from the beryllium blocks. Therefore, the model source areas were modified to account explicitly for the beryllium blocks. The remainder of the waste was grouped by the year of disposal. Figure 4-2 shows the C-14 source areas. The source model also used 18 source areas for the VOCs, but three of the source areas (Pit 4, Pit 5, and Pit 10) were a subset of the grid blocks used for the radionuclides. The infiltration rate was adjusted for the smaller source areas. Tables 4-13 through 4-15 show the inventory in the individual source areas. These tables show the total inventory of each contaminant in each source area. Appendix B contains the division of these source-area allocations by year. Tables 4-16 and 4-17 show the inventories for Group 6 (Tc-99, I-129, and Cl-36) and Group 8 (C-14), respectively, as they remain at milestones associated with grouting. These inventories are used to restart the source-release modeling with altered conditions. The inventories are the grouted portion and nongrouted portions after the grouting is completed in 2004, and the remaining grouted inventory when the grout fails after 1,038 years, in calendar year 3042.

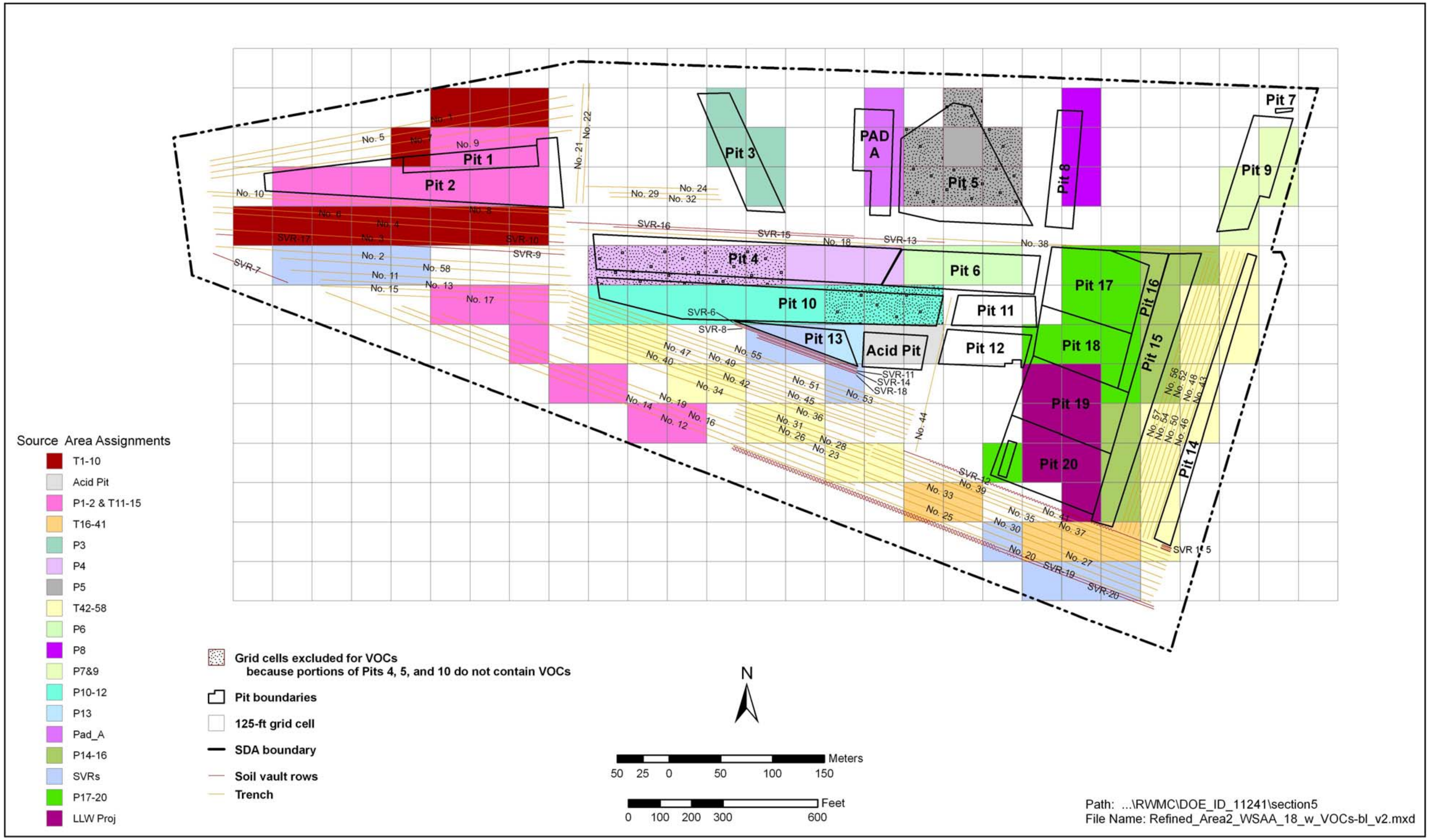


Figure 4-1. Eighteen source areas simulated for all contaminants, except carbon-14, in the source-release model and specifically represented in the subsurface-model domain.

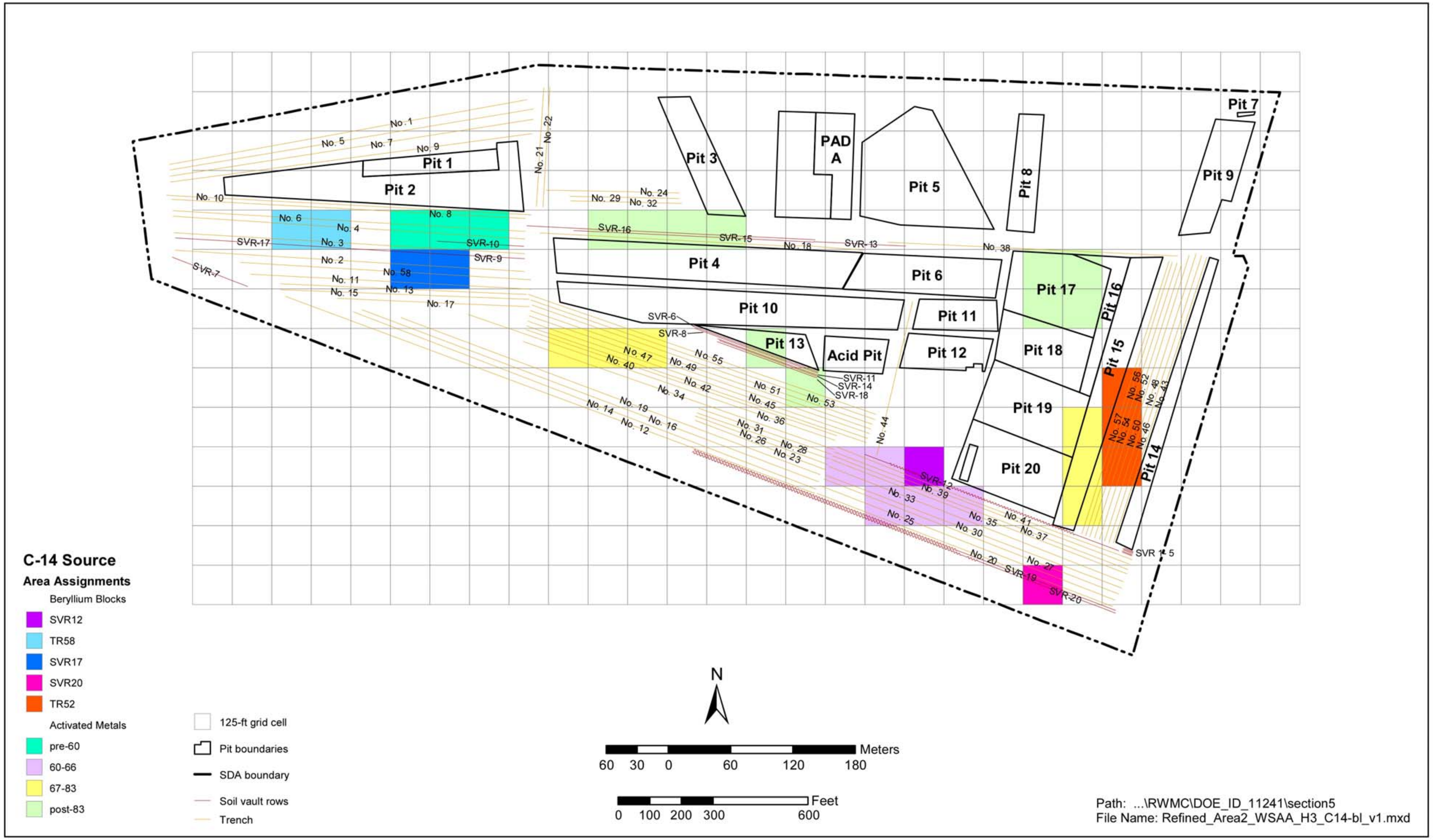


Figure 4-2. Nine carbon-14 source areas simulated in the source-release model and specifically represented in the subsurface-model domain.

Table 4-13. Activity (Ci) of radionuclides (Groups 1–6 and 9) buried in the 18 simulated source areas, by simulation groups and waste stream types, for the Subsurface Disposal Area modeling.

Group	Radionuclide	**Total**	T1–10	Acid Pit	P1-2 and T11–15	T16–41	P3	P4	P5	T42–58	P6	P8	P7 and 9	P10–12	P13	Pad A	P14–16	SVRs	P17–20	LLW_ proj
1	Am-241	**2.43E+05**	2.08E+04	4.14E-04	7.71E+04	4.36E+02	2.15E+03	5.15E+04	2.88E+04	1.18E+02	1.19E+04	5.11E-02	1.02E+04	3.98E+04	6.99E-01	5.34E+01	2.68E+00	4.12E+00	2.95E+00	1.19E+00
	Np-237	**1.41E-01**	2.30E-03	2.79E-07	1.40E-04	4.96E-02	2.71E-05	2.61E-05	8.59E-05	2.35E-02	9.79E-07	1.59E-05	1.68E-06	1.01E-03	1.47E-03	3.73E-07	8.55E-03	2.20E-02	9.89E-03	2.28E-02
	U-233	**2.12E+00**	9.52E-07	6.39E-11	7.77E-07	5.51E-01	3.25E-03	7.94E-09	4.59E-01	6.48E-01	8.15E-02	3.74E-09	4.29E-09	2.46E-08	3.84E-07	3.55E-14	1.13E-05	8.33E-05	3.56E-01	1.74E-02
	Th-229	**7.14E-06**	3.21E-09	6.49E-13	2.06E-10	2.07E-09	4.98E-12	1.75E-12	3.82E-12	4.80E-07	2.99E-13	4.79E-12	9.00E-13	6.35E-11	2.79E-10	4.87E-22	9.43E-09	1.07E-07	6.54E-06	0.00E+00
2	Am-243	**1.18E-01**	1.14E-02	2.18E-06	7.51E-04	4.57E-03	1.92E-05	1.84E-05	9.26E-06	5.97E-02	1.33E-06	2.20E-05	3.16E-06	2.25E-04	1.02E-03	6.94E-11	1.28E-02	2.44E-02	1.11E-03	1.88E-03
	Pu-239[a]	**2.33E+03**	2.42E+01	0.00E+00	7.26E+02	2.12E+00	1.23E+02	4.77E+02	1.56E+02	0.00E+00	1.27E+02	0.00E+00	1.10E+02	5.85E+02	0.00E+00	1.16E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Pu-239	**6.18E+04**	6.30E+02	5.38E-05	1.92E+04	9.02E+01	3.21E+03	1.26E+04	4.07E+03	3.97E+02	3.31E+03	8.43E-02	2.85E+03	1.52E+04	2.44E+01	3.03E+01	2.47E+01	8.87E+01	4.49E+00	5.07E-01
	U-235	**4.88E+00**	1.01E+00	2.32E-03	7.23E-01	4.41E-01	7.45E-02	2.91E-01	3.28E-01	9.77E-02	2.19E-01	2.42E-05	3.74E-02	3.35E-01	1.65E-02	2.99E-01	5.99E-01	3.85E-02	3.23E-01	3.82E-02
	Pa-231	**8.61E-04**	3.90E-07	7.48E-11	2.56E-08	5.56E-07	6.37E-10	4.48E-10	2.69E-10	1.15E-06	4.11E-11	6.77E-10	1.09E-10	7.71E-09	3.42E-08	1.35E-15	7.08E-07	3.94E-07	8.58E-04	0.00E+00
	Ac-227	**4.29E-06**	3.90E-07	7.48E-11	2.56E-08	5.56E-07	6.37E-10	4.48E-10	2.69E-10	1.15E-06	4.11E-11	6.77E-10	1.09E-10	7.71E-09	3.42E-08	1.35E-15	7.08E-07	3.94E-07	1.02E-06	0.00E+00
3	Pu-240[a]	**5.22E+02**	5.41E+00	0.00E+00	1.63E+02	4.74E-01	2.76E+01	1.05E+02	3.52E+01	0.00E+00	2.91E+01	0.00E+00	2.51E+01	1.32E+02	0.00E+00	1.86E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Pu-240	**1.41E+04**	1.41E+02	4.13E-05	4.52E+03	1.85E+01	7.19E+02	2.88E+03	9.17E+02	4.31E+01	7.58E+02	2.03E-02	6.54E+02	3.43E+03	4.90E-01	5.06E+00	8.53E-01	2.22E+00	4.74E-01	1.83E-01
	U-236	**1.45E+00**	3.52E-01	4.44E-08	1.52E-01	1.38E-01	4.89E-03	1.43E-01	1.56E-01	9.94E-02	6.21E-02	4.56E-05	1.90E-02	1.43E-01	6.29E-03	1.42E-02	1.54E-02	6.80E-02	5.95E-02	1.75E-02
	Th-232	**3.51E+00**	1.06E-11	2.03E-15	1.08E+00	9.36E-01	4.06E-08	2.28E-01	2.36E-07	1.05E+00	1.09E-15	7.39E-08	2.81E-08	4.35E-05	3.79E-05	2.81E-05	1.18E-02	1.50E-01	2.58E-02	2.75E-02
	Ra-228	**3.66E-05**	2.27E-10	4.36E-14	1.48E-11	6.84E-11	3.65E-13	1.24E-13	1.54E-13	1.17E-07	2.07E-14	3.36E-13	6.32E-14	4.49E-12	2.01E-11	1.38E-24	2.59E-10	3.20E-08	1.07E-05	2.57E-05
4	Pu-238[b]	**2.08E+03**	4.06E+01	3.45E-03	6.04E+02	1.02E+02	1.03E+02	3.90E+02	1.26E+02	4.13E+01	1.03E+02	4.89E-02	8.72E+01	4.12E+02	4.06E+00	9.67E-01	2.00E+01	4.44E+01	2.05E+00	4.91E-01
5	U-238	**1.48E+02**	6.06E+00	9.90E-02	1.63E+01	2.61E+00	6.25E-01	2.63E+01	2.01E+01	2.51E+00	1.28E+01	6.46E-05	1.45E+00	2.40E+01	1.39E-02	2.21E+01	2.00E+00	5.61E-02	3.95E+00	7.39E+00
	U-234	**6.26E+01**	6.05E+00	6.59E-02	1.18E+01	7.89E+00	6.78E-01	3.91E+00	4.85E+00	3.25E+00	4.31E+00	7.61E-04	1.95E+00	6.87E+00	1.52E-01	4.21E+00	1.85E+00	7.51E-01	3.62E+00	4.07E-01
	Th-230	**5.77E-02**	1.22E-09	5.68E-06	4.08E-07	9.23E-05	1.05E-08	4.53E-08	6.16E-09	4.15E-05	1.52E-09	2.41E-08	1.58E-09	1.14E-07	5.41E-07	1.79E-02	6.15E-05	1.51E-05	1.34E-02	2.62E-02
	Ra-226	**6.51E+01**	3.24E-10	1.50E-06	2.42E+01	3.76E+01	3.90E-03	2.74E+00	1.09E-09	4.30E-02	1.38E-10	2.27E-09	4.29E-10	4.27E-08	1.41E-07	1.72E-02	2.00E-01	1.02E-06	7.91E-02	1.91E-01
	Pb-210	**5.59E-07**	2.27E-12	1.06E-08	6.75E-10	5.04E-09	1.47E-11	5.76E-12	6.94E-12	1.00E-08	9.62E-13	1.23E-11	2.93E-12	2.09E-10	9.25E-10	0.00E+00	1.38E-08	7.11E-09	5.10E-07	0.00E+00
6	Tc-99[c]	**1.50E+01**	1.56E-03	0.00E+00	4.35E-03	3.32E-01	1.65E-04	2.06E-03	5.65E-03	2.12E-01	7.73E-05	1.40E-05	2.46E-05	1.27E-03	4.05E-05	0.00E+00	1.52E-01	1.43E+01	8.73E-04	3.46E-03
	I-129[c]	**7.44E-04**	1.20E-06	0.00E+00	5.79E-06	5.53E-04	3.01E-07	4.33E-06	9.50E-06	1.54E-04	1.40E-07	1.95E-07	4.04E-08	4.70E-07	6.64E-08	0.00E+00	2.96E-06	1.20E-05	1.20E-06	0.00E+00
	Cl-36[c]	**7.52E-01**	2.14E-04	0.00E+00	3.67E-04	4.84E-02	6.72E-09	1.72E-12	6.30E-10	1.07E-01	2.54E-12	2.35E-08	2.74E-12	1.51E-07	4.72E-09	0.00E+00	9.90E-04	5.73E-02	4.92E-07	5.38E-01
	Tc-99[d]	**1.20E-02**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.51E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.46E-03	0.00E+00	0.00E+00
	I-129[d]	**9.91E-05**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.19E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.73E-05	0.00E+00	0.00E+00
	Cl-36[d]	**8.83E-01**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.41E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.41E-01	0.00E+00	0.00E+00
	Tc-99[e]	**4.24E+00**	2.61E-02	0.00E+00	0.00E+00	1.15E+00	0.00E+00	2.89E-04	1.26E-04	2.14E+00	6.26E-07	8.26E-05	0.00E+00	1.42E-01	5.00E-02	5.65E-05	1.06E-01	6.20E-01	0.00E+00	0.00E+00
	I-129[e]	**9.18E-03**	4.52E-05	0.00E+00	0.00E+00	1.99E-03	0.00E+00	0.00E+00	0.00E+00	5.25E-03	0.00E+00	7.49E-11	3.60E-10	2.92E-04	1.03E-04	1.16E-07	2.21E-04	1.28E-03	0.00E+00	0.00E+00
	Cl-36[e]	**1.49E-03**	0.00E+00	0.00E+00	0.00E+00	2.63E-04	0.00E+00	0.00E+00	0.00E+00	1.20E-03	0.00E+00	1.23E-12	0.00E+00	4.78E-06	1.68E-06	1.91E-09	3.56E-06	2.09E-05	0.00E+00	0.00E+00
	Tc-99[f]	**6.26E+00**	4.63E-04	0.00E+00	0.00E+00	6.70E-01	0.00E+00	8.81E-06	5.66E-08	9.27E-01	0.00E+00	0.00E+00	1.18E-05	5.34E-05	1.18E-01	0.00E+00	1.71E+00	0.00E+00	7.90E-01	2.05E+00
	I-129[f]	**1.33E-01**	1.76E-06	0.00E+00	7.41E-08	1.66E-02	0.00E+00	3.48E-08	2.23E-10	2.39E-02	0.00E+00	0.00E+00	4.64E-08	2.11E-07	2.94E-03	0.00E+00	2.34E-02	0.00E+00	1.96E-02	4.65E-02
	Cl-36[f]	**0.00E+00**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Tc-99[g]	**6.67E+00**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.67E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	I-129[g]	**1.80E-02**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.80E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Cl-36[g]	**0.00E+00**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Tc-99[h]	**1.07E+01**	8.14E-01	1.64E-04	5.22E-02	4.01E+00	2.94E-03	7.77E-04	1.91E-03	2.48E+00	7.61E-05	2.83E-03	3.69E-04	2.26E-02	2.19E-01	1.94E-07	9.53E-01	1.92E+00	2.11E-01	3.67E-02
	I-129[h]	**2.38E-02**	1.30E-03	2.50E-07	8.52E-05	9.41E-03	5.24E-06	1.40E-06	3.17E-06	4.70E-03	1.26E-07	4.53E-06	6.61E-07	3.93E-05	4.15E-04	3.98E-10	1.55E-03	3.14E-03	3.93E-04	2.71E-03
	Cl-36[h]	**6.72E-03**	1.86E-10	0.00E+00	4.12E-06	9.00E-06	6.64E-09	8.97E-07	3.76E-08	3.83E-03	2.51E-15	1.18E-08	4.47E-09	2.18E-07	4.33E-06	6.10E-12	1.33E-03	1.44E-03	9.67E-05	0.00E+00

Table 4-13. (continued).

Group	Radionuclide	Total	T1–10	Acid Pit	P1-2 and T11–15	T16–41	P3	P4	P5	T42–58	P6	P8	P7 and 9	P10–12	P13	Pad A	P14–16	SVRs	P17–20	LLW_ proj
9	Nb-94	**8.38E+01**	1.55E+00	0.00E+00	7.29E-02	4.44E+01	1.45E-04	0.00E+00	3.01E-02	1.01E+01	1.21E-04	7.86E-05	1.31E-04	1.79E+00	4.42E-04	2.55E-07	4.18E-01	2.20E+01	5.75E-01	2.83E+00
	Sr-90	**2.76E+04**	1.93E+02	0.00E+00	1.05E+03	9.84E+03	1.49E+00	0.00E+00	3.82E+01	1.08E+04	4.91E-01	6.64E-01	1.65E-01	8.40E+02	2.96E+02	3.34E-01	6.54E+02	3.67E+03	5.13E+00	0.00E+00
	Totals		**2.18E+04**	**1.71E-01**	**1.03E+05**	**1.06E+04**	**6.34E+03**	**6.80E+04**	**3.42E+04**	**1.14E+04**	**1.63E+04**	**8.72E-01**	**1.39E+04**	**6.04E+04**	**3.26E+02**	**1.18E+02**	**7.10E+02**	**3.85E+03**	**2.51E+01**	**1.60E+01**

a. Colloidal or mobile portion of plutonium.
b. Inventories for Group 4 daughter products (i.e., U-234, Th-230, Ra-226, and Pb-210) are included in Group 5.
c. Associated with activated metal (called C-14A in the model).
d. Associated with beryllium blocks (called C-14B in the model).
e. Associated with fuel-like materials (called C-14F in the model).
f. Associated with resins (called C-14R in the model).
g. Associated with Vycor glass (called C-14V in the model).
h. Subject to surface wash (called C-14W in the model).

Table 4-14. Mass (g) of volatile organic compounds and nonradionuclides (Groups 10 and 11) buried in the 18 simulated source areas, by simulation groups, for the Subsurface Disposal Area modeling.

Group	Contaminant	Total	T1–10	Acid Pit	P1-2 and T11–15	T16–41	P3	P4	P5	T42–58	P6	P8	P7 and 9	P10–12	P13	Pad A	P14–16	SVRs	P17–20	LLW_proj
10	Nitrate	**4.56E+08**	0.00E+00	4.97E+07	1.52E+04	4.02E+01	7.80E+03	0.00E+00	0.00E+00	0.00E+00	5.16E+07	0.00E+00	6.89E+06	1.08E+08	0.00E+00	2.35E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Chromium[a]	**2.31E+06**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E+05	0.00E+00	1.99E+04	3.16E+05	0.00E+00	1.82E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
11	Carbon tetrachloride	**7.86E+08**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.48E+08	3.45E+06	0.00E+00	2.36E+08	0.00E+00	1.03E+08	9.57E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Methylene chloride	**1.41E+07**	7.05E+05	0.00E+00	2.62E+06	1.58E+04	1.02E+05	3.19E+06	1.61E+06	0.00E+00	1.15E+06	0.00E+00	9.79E+05	3.71E+06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Tetrachloroethylene	**9.87E+07**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.33E+07	5.37E+05	0.00E+00	2.91E+07	0.00E+00	1.26E+07	1.31E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Trichloroethylene[b]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	1,4-Dioxane	**3.90E+06**	8.62E+03	0.00E+00	3.41E+04	9.64E+02	4.01E+03	7.90E+05	3.00E+04	2.67E+03	5.20E+05	1.58E+02	2.28E+05	2.99E+05	1.43E+02	0.00E+00	3.37E+04	2.39E-01	2.39E+00	0.00E+00
	Totals		**7.14E+05**	**4.97E+07**	**2.67E+06**	**1.68E+04**	**1.14E+05**	**3.95E+08**	**5.63E+06**	**2.67E+03**	**3.19E+08**	**1.58E+02**	**1.24E+08**	**2.21E+08**	**1.43E+02**	**2.37E+08**	**3.37E+04**	**2.39E-01**	**2.39E+00**	**0.00E+00**

a. For modeling performance assessment only.
b. Simulations for trichloroethylene will be part of the feasibility study; value not yet computed.

Table 4-15. Activity (Ci) of carbon-14 (Group 8) in beryllium blocks buried in the nine simulated source areas, by simulation groups, for the Subsurface Disposal Area modeling.

Group	Radionuclide	Total	TR58	SVR12	SVR17	SVR20	TR52	Pre-60	60–66	67–83	Post-83
8	C-14[a]	**5.02E+02**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E+01	2.31E+02	1.52E+02	1.07E+02
	C-14[b]	**9.24E+01**	3.67E+01	5.83E+00	1.59E+01	1.20E+01	2.20E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	C-14[c]	**6.57E+00**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.16E-07	6.50E+00	5.73E-02	1.42E-02
	C-14[d]	**2.61E+01**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-01	2.87E+00	1.36E+01	9.34E+00
	C-14[e]	**1.04E+02**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.06E-02	5.77E+01	3.99E+01	5.95E+00
	Totals		**3.67E+01**	**5.83E+00**	**1.59E+01**	**1.20E+01**	**2.20E+01**	**1.19E+01**	**2.98E+02**	**2.06E+02**	**1.22E+02**

a. Associated with activated metal (called C-14A in the model).
b. Associated with beryllium blocks (called C-14A in the model).
c. Associated with fuel-like materials (called C-14F in the model).
d. Associated with resins (called C-14R in the model).
e. Associated with surface wash (called C-14W in the model).

Table 4-16. Revised modeled activity (Ci) of radionuclides (Group 6) at time of grouting and at time of grout failure.

Group	Radionuclide	**Total**	T1–10	Acid Pit	P1-2 and T11–15	T16–41	P3	P4	P5	T42–58	P6	P8	P7 and 9	P10–12	P13	Pad A	P14–16	SVRs	P17–20	LLW_ proj
6	Tc-99[a]	**7.52E-04**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.65E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.15E-04	0.00E+00	0.00E+00
	I-129[a]	**5.82E-06**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.86E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.53E-06	0.00E+00	0.00E+00
	Cl-36[a]	**4.90E-02**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.36E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.66E-02	0.00E+00	0.00E+00
	Tc-99[b]	**1.05E-02**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.93E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.58E-03	0.00E+00	0.00E+00
	I-129[b]	**9.33E-05**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.16E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.18E-05	0.00E+00	0.00E+00
	Cl-36[b]	**7.80E-01**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.97E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.83E-01	0.00E+00	0.00E+00
	Tc-99[c]	**4.71E-03**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.55E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.16E-03	0.00E+00	0.00E+00
	I-129[c]	**4.03E-03**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.09E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.39E-04	0.00E+00	0.00E+00
	Cl-36[c]	**1.80E-01**	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.38E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.23E-02	0.00E+00	0.00E+00

a. Portion that is not grouted after grouting is completed in 2004 (called Tc-99N, I-129N, and Cl-36N in the model).
b. Portion that is grouted in 2004 (called Tc-99G, I-129G, and Cl-36G in the model). The release mechanism is corrosion of the beryllium. The grout reduces the surface area in contact with infiltrating water and reduces the corrosion rate.
c. Remaining after grout has failed (called Tc-99E, I-129E, and Cl-36E in the model, for the end state). Grout is expected to remain effective for a minimum of 1,038 years (CY 3042) (Hanson et al. 2004).

Table 4-17. Revised modeled activity (Ci) of carbon-14 (Group 8) in beryllium blocks at time of grouting and at time of grout failure.

Group	Radionuclide	**Total**	TR58	SVR12	SVR17	SVR20	TR52	Pre-60	60–66	67–83	Post-83
8	C-14[a]	**6.76E+00**	1.30E+00	5.46E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	C-14[b]	**7.91E+01**	3.25E+01	0.00E+00	1.51E+01	1.16E+01	1.99E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	C-14[c]	**3.14E+01**	1.29E+01	0.00E+00	6.00E+00	4.59E+00	7.88E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

a. Portion that is not grouted after grouting is completed in 2004 (called C-14N in the model)
b. Portion that is grouted in 2004 (called C-14G in the model). The release mechanism is corrosion of the beryllium. The grout reduces the surface area in contact with infiltrating water and reduces the corrosion rate.
c. Remaining after grout has failed (called C-14E in the model, for the end state). Grout is expected to remain effective for a minimum of 1,038 years (CY 3042) (Hanson et al. 2004).

4.6 Infiltration Rates

Site-specific infiltration rates were developed for the SDA. The infiltration rate assigned to each of the 27 source areas (18 for radionuclides and nine for carbon-14) was based on the assignment of infiltration in the subsurface flow and transport model. Infiltration rates applied to the grid blocks of the subsurface flow and transport model along with the 27 source areas are presented in Figures 4-3, 4-4, and 4-5. Infiltration assigned in the subsurface model was averaged over the grid blocks representing the source areas. The resulting averages are shown at the bottom of the figures. These cell-distinct infiltration rates were replaced by a single, fixed infiltration rate, for all source areas, of 23 cm/yr (9 in./yr) for the high infiltration case and 0.1 cm/yr (0.039 in./yr) for the low infiltration and all cap cases (Magnuson and Sondrup 2006).

DUST-MS requires assigning both soil moisture content and infiltration rate. One parameter can be estimated from the other using van Genuchten's equation. The van Genuchten parameters used for the SDA are taken from Baca et al. (1992) and McElroy and Hubbell (1990), and are shown in Table 4-18. Figure 4-6 shows the relationship between infiltration rate and moisture content using these parameter values.

4.7 Release Parameters

Each contaminant will have a unique set of release parameters depending on the chemistry of the system. Release parameters used in the source-release modeling consist of distribution coefficients, solubility limits, corrosion rates, and diffusion coefficients.

4.7.1 Distribution Coefficients

Distribution coefficients (K_d) are used to simulate release via the surface-wash release mechanism. Distribution coefficients describe a chemical or radiological constituent's tendency to dissolve in water, as compared to its tendency to adsorb to solids, in this case, soil. Contaminants that can be freely rinsed off of the surface of the host material will either adsorb to the surrounding soil or will dissolve in transient water and be washed away. The dissolved fraction is mobile and transports at the velocity of groundwater flow. The adsorbed fraction reduces the concentration and retards transport of the contaminant plume. The comparison between the two tendencies is presented as a ratio of the volume dissolved to the mass adsorbed. Ideally, site-specific waste-to-water distribution coefficients would be developed for use in the model. However, because of cost and the heterogeneity of the waste, soil-to-water distribution coefficients are used instead. These are the best approximation to a waste-to-water distribution coefficient available. Table 4-8 presents the distribution coefficients used in the source-release modeling.

4.7.2 Solubility Limits

Chemical and radiological constituents will dissolve in water only to the point of solution saturation. Once the solution is saturated, dissolution ceases and the remaining constituent persists in suspended, solid form. The solubility limit defines the saturation limit, or concentration at which dissolution ceases, for the constituent. The dissolved concentration predicted by the distribution coefficient cannot physically exceed the solubility limit. Thus, the solubility limit determines the maximum concentration that will be available for transport. Table 4-19 presents the solubility limits used in the source-release modeling.

Simulated Infiltration (cm/year)

1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	3.7	3.7	3.7	1.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	10.0	10.0	10.0	10.0	1.0
10.0	10.0	10.0	3.7	1.0	1.0	3.7	3.7	1.0	1.0	10.0	1.0	1.0	3.7	3.7	1.0	3.7	10.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	1.0
10.0	10.0	3.7	3.7	1.0	1.0	3.7	3.7	1.0	3.7	10.0	1.0	1.0	3.7	10.0	10.0	3.7	10.0	3.7	1.0	3.7	3.7	1.0	1.0	3.7	1.0	3.7	1.0
3.7	10.0	10.0	3.7	3.7	10.0	10.0	10.0	10.0	10.0	3.7	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	3.7	3.7	3.7	3.7	3.7	3.7	10.0	1.0
10.0	10.0	3.7	3.7	3.7	3.7	10.0	10.0	10.0	3.7	3.7	3.7	10.0	1.0	1.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	10.0	1.0	1.0
1.0	1.0	3.7	3.7	3.7	3.7	3.7	3.7	10.0	3.7	3.7	3.7	10.0	1.0	1.0	1.0	1.0	1.0	10.0	3.7	3.7	3.7	3.7	3.7	3.7	10.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	10.0	10.0	10.0	10.0	10.0	3.7	3.7	10.0	3.7	10.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	3.7	3.7	10.0	10.0	10.0	10.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	10.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	3.7	10.0	10.0	3.7	1.0	1.0	1.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	3.7	3.7	3.7	1.0	1.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	10.0	10.0	3.7	3.7	3.7	3.7	3.7	3.7	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	10.0	10.0	10.0	3.7	10.0	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	3.7	10.0	10.0	1.0	1.0	1.0	1.0

T1-10	Acid_Pit	P1-2&T11-15	T16-41	P3	P4	P5	T42-58	P6	P8	P7&9	P10-12	P13	Pad_A	P14-16	SVRs	P17-20	LLW_proj
5.9	6.8	3.6	7.5	3.0	3.8	4.3	6.4	3.7	2.8	3.0	2.9	10.0	3.7	3.7	5.4	3.7	3.7

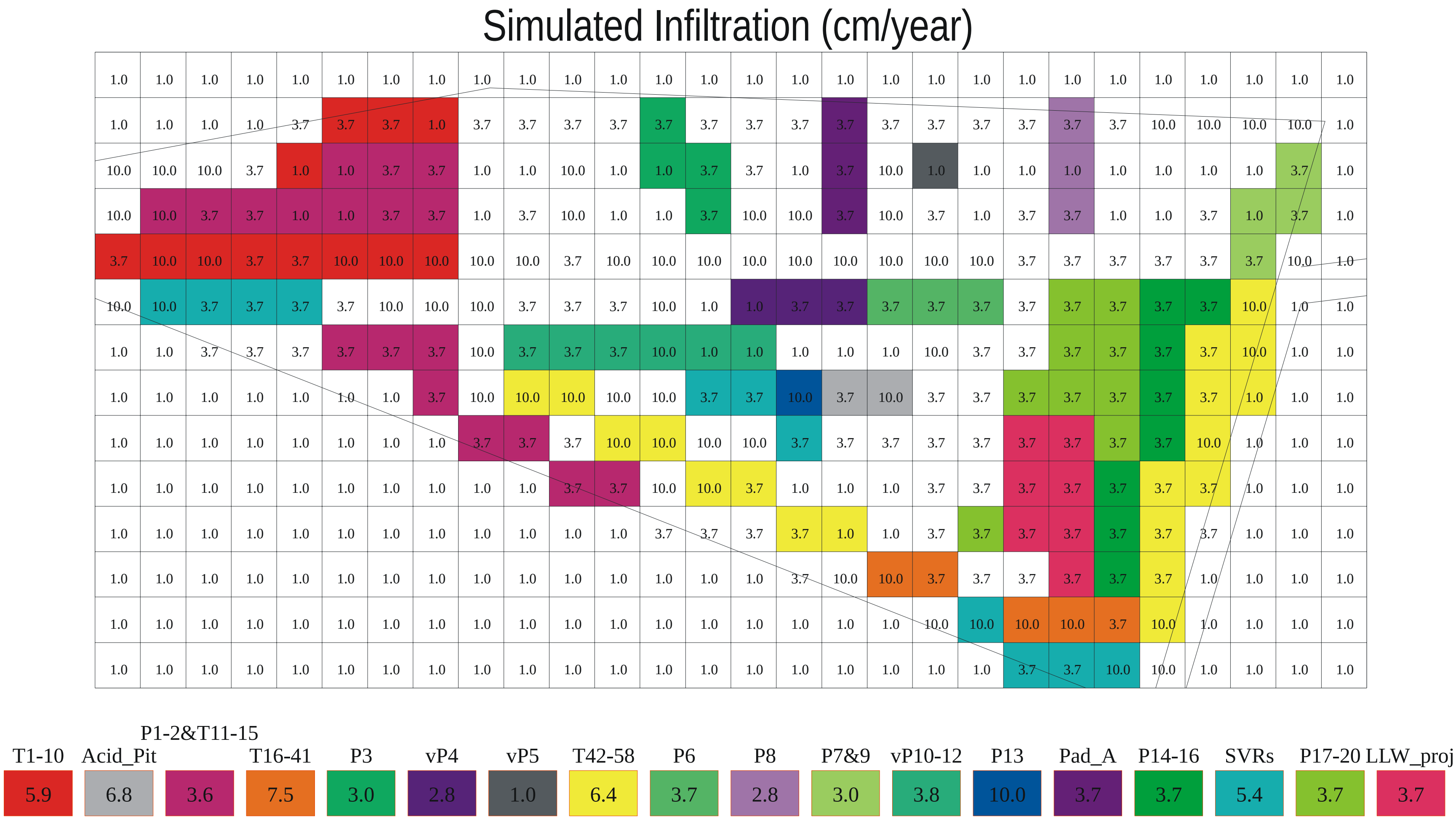
Figure 4-3. Subsurface Disposal Area infiltration rates for radionuclides and nitrates (except carbon-14).

Simulated Infiltration (cm/year)

1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	3.7	3.7	3.7	1.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	10.0	10.0	10.0	10.0	1.0
10.0	10.0	10.0	3.7	1.0	1.0	3.7	3.7	1.0	1.0	10.0	1.0	1.0	3.7	3.7	1.0	3.7	10.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	1.0
10.0	10.0	3.7	3.7	1.0	1.0	3.7	3.7	1.0	3.7	10.0	1.0	1.0	3.7	10.0	10.0	3.7	10.0	3.7	1.0	3.7	3.7	1.0	1.0	3.7	1.0	3.7	1.0
3.7	10.0	10.0	3.7	3.7	10.0	10.0	10.0	10.0	10.0	3.7	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	3.7	3.7	3.7	3.7	3.7	3.7	10.0	1.0
10.0	10.0	3.7	3.7	3.7	3.7	10.0	10.0	10.0	3.7	3.7	3.7	10.0	1.0	1.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	10.0	1.0	1.0
1.0	1.0	3.7	3.7	3.7	3.7	3.7	3.7	10.0	3.7	3.7	3.7	10.0	1.0	1.0	1.0	1.0	1.0	10.0	3.7	3.7	3.7	3.7	3.7	3.7	10.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	10.0	10.0	10.0	10.0	10.0	3.7	3.7	10.0	3.7	10.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	3.7	3.7	10.0	10.0	10.0	10.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	10.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	3.7	10.0	10.0	3.7	1.0	1.0	1.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	3.7	3.7	3.7	1.0	1.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	10.0	10.0	3.7	3.7	3.7	3.7	3.7	3.7	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	10.0	10.0	10.0	3.7	10.0	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	3.7	10.0	10.0	1.0	1.0	1.0	1.0

SVR12	TR58	SVR17	SVR20	TR52	pre-60	60-66	67-83	post-83
3.7	6.8	6.8	3.7	3.7	10.0	3.9	6.8	5.6

Figure 4-4. Subsurface Disposal Area infiltration rates for carbon-14.



1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	3.7	3.7	3.7	1.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	10.0	10.0	10.0	10.0	1.0
10.0	10.0	10.0	3.7	1.0	1.0	3.7	3.7	1.0	1.0	10.0	1.0	1.0	3.7	3.7	1.0	3.7	10.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	1.0
10.0	10.0	3.7	3.7	1.0	1.0	3.7	3.7	1.0	3.7	10.0	1.0	1.0	3.7	10.0	10.0	3.7	10.0	3.7	1.0	3.7	3.7	1.0	1.0	3.7	1.0	3.7	1.0
3.7	10.0	10.0	3.7	3.7	10.0	10.0	10.0	10.0	10.0	3.7	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	3.7	3.7	3.7	3.7	3.7	3.7	10.0	1.0
10.0	10.0	3.7	3.7	3.7	3.7	10.0	10.0	10.0	3.7	3.7	3.7	10.0	1.0	1.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	10.0	1.0	1.0
1.0	1.0	3.7	3.7	3.7	3.7	3.7	3.7	10.0	3.7	3.7	3.7	10.0	1.0	1.0	1.0	1.0	1.0	10.0	3.7	3.7	3.7	3.7	3.7	3.7	10.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	10.0	10.0	10.0	10.0	10.0	3.7	3.7	10.0	3.7	10.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	3.7	3.7	10.0	10.0	10.0	10.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	10.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	3.7	10.0	10.0	3.7	1.0	1.0	1.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	3.7	3.7	3.7	1.0	1.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	10.0	10.0	3.7	3.7	3.7	3.7	3.7	3.7	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	10.0	10.0	10.0	10.0	3.7	10.0	1.0	1.0	1.0	1.0
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.7	3.7	10.0	10.0	1.0	1.0	1.0	1.0

Figure 4-5. Subsurface Disposal Area infiltration rates for volatile organic compounds.

Table 4-18. Van Genuchten parameters.

Van Genuchten Parameter	Symbol	Value (cm/sec)	Value (m/yr)
Saturated hydraulic conductivity (cm/sec)[a]	K_s	7.58E-05	23.904
Saturated water content (cm^3/cm^3)	θ_s	0.487	0.487
Residual water content (cm^3/cm^3)	θ_r	0.142	0.142
Curve shape parameter (cm^{-1})	α	0.01066	1.066
Curve shape parameter	n	1.523	1.523
Curve shape parameter (m = 1 – 1/n)	m	0.343	0.343
Tortuosity/connectivity parameter	L	0.5	0.5

Note: Information in this table is from Baca et al. (1992) and McElroy and Hubbell (1990).

a. Hydraulic conductivity adjusted per S. Magnuson.

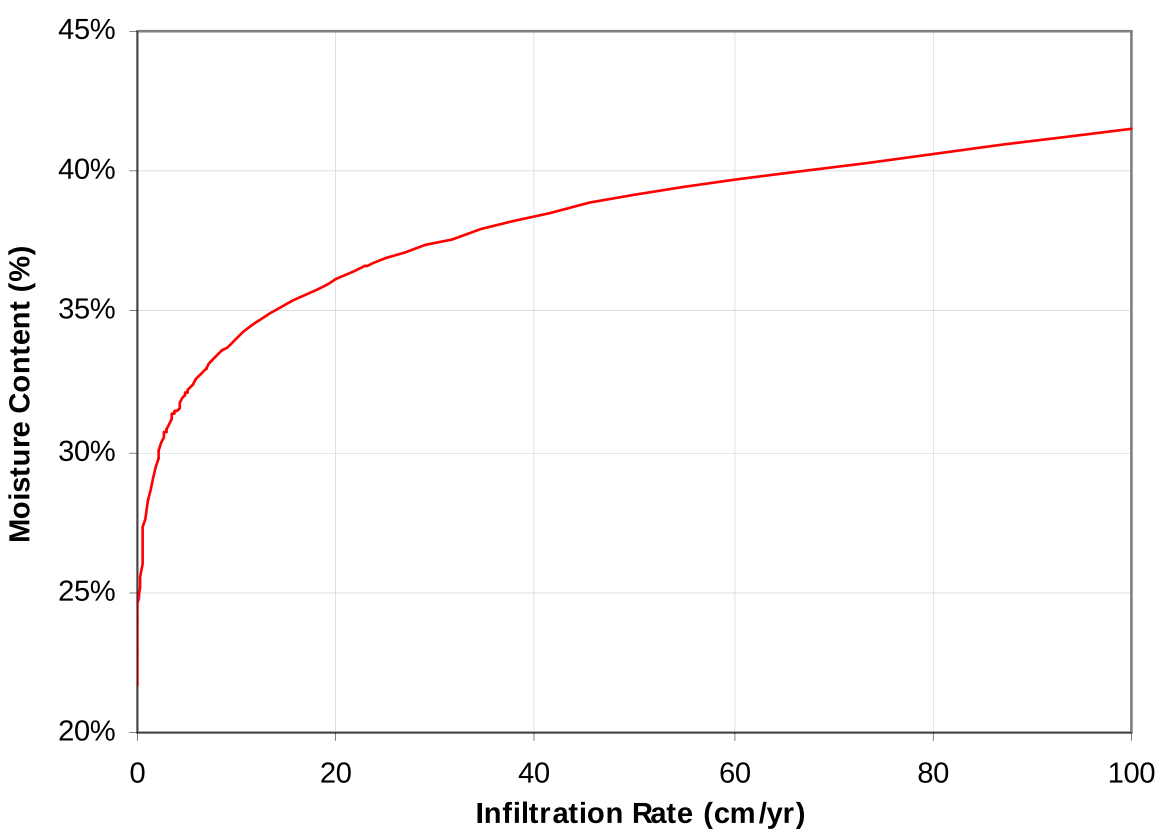


Figure 4-6. Relationship between moisture content and infiltration rate.

Table 4-19. Solubility limits (g/cm³).

Contaminant	Ancillary Basis for Risk Analysis and Preliminary Evaluation of Remedial Alternatives	Remedial Investigation and Baseline Risk Assessment and Feasibility Study[a,b]
Ac-227	NSL[c]	2.05E-12
Am-241	NSL	2.20E-12
Am-243	NSL	2.20E-12
C-14	NSL	1.25E-04
Cl-36	NSL	NSL
I-129	NSL	NSL
Nb-94	NSL	7.98E-18
Np-237	NSL	1.10E-03
Pa-231	NSL	1.09E-03
Pb-210	NSL	1.69E-09
Pu-238	NSL	6.15E-15
Pu-239	NSL	6.15E-15
Pu-239 (mobile/colloidal)	NSL	NSL
Pu-240	NSL	6.15E-15
Pu-240 (mobile/colloidal)	NSL	NSL
Ra-226	NSL	9.83E-09
Ra-228	NSL	9.83E-09
Sr-90	NSL	6.40E-07
Tc-99	NSL	1.59E-02
Th-229	NSL	2.61E-06
Th-230	NSL	2.61E-06
Th-232	NSL	2.61E-06
U-233	NSL	9.12E-07[d]
U-234	NSL	2.05E-11[e]
U-235	NSL	2.89E-08[e]
U-236	NSL	9.12E-07[d]
U-238	NSL	8.83E-07[e]
Chromium	NA[f]	NSL
Nitrate	NSL	NSL
Carbon tetrachloride	NA[g]	NSL
Methylene chloride	NA[g]	NSL
Tetrachloroethylene	NA[g]	NSL
Trichloroethylene[h]	NA[g]	NSL
1,4-Dioxane	NA[g]	NSL

a. Green shading indicates a change compared to the value used in the Ancillary Basis for Risk Analysis and Preliminary Evaluation of Remedial Alternatives. All changes are based on Riley and Lo Presti (2004).
b. Oxidized conditions are conservatively assumed, though reduced conditions currently prevail in the buried waste. In most cases, the solubility limit was the same for both oxidized and reduced conditions.
c. NSL indicates the contaminant is not solubility limited.
d. Used the total solubility for all uranium. See text for explanation.
e. Used a mass ratio for the individual isotopes rather than the total solubility for all uranium. See text for explanation.
f. NA = not applicable. Chromium was not modeled in the Ancillary Basis for Risk Analysis and Preliminary Evaluation of Remedial Alternatives.
g. NA = not applicable. Volatile organic compounds were not modeled for the Ancillary Basis for Risk Analysis and Preliminary Evaluation of Remedial Alternatives. (Volatile organic compounds were not solubility-limited for the Interim Risk Assessment.)
h. Simulations for trichloroethylene will be part of the feasibility study; value not yet computed.

For all contaminants except uranium, the total solubility is used for each individual isotope. This is conservative because the total mass in solution could be greater than the solubility limit. Plus, this simplified the development of solubility limits because it eliminated the need to determine what the fraction of the total each isotope would be. This fraction would change through time as isotopes decay and others grow in. However, for uranium, a different methodology was used. The one monitoring data point from the waste zone indicates that the release of uranium will be limited. Analytical computation of the limit (Hull and Pace 2000) indicated a solubility limit of 0.9 mg/L for uranium. The value measured in Lysimeter 741-00-L1 on November 7, 2001, indicated a value of 0.89 mg/L. On a mass basis, U-238 dominates the disposals of uranium; therefore, the solubility limit for the other isotopes would be much less than the total value. The half-lives of the three major isotopes, U-234, U-235, and U-238, are so long compared to the simulation period that the relative contribution to the total mass will not change significantly. Therefore, the disposed mass of these three isotopes was used to develop an isotope-specific solubility limit for U-234, U-235, and U-238. The half-lives of the other isotopes are much shorter; therefore, the solubility limit would change over time. The conservative limit of the total uranium solubility was used for U-233 and U-236.

4.7.3 Corrosion Rates

Some radiological constituents, such as activation products imbedded in the molecular structure of activated metal or fission products integral to the reactor fuels, are not immediately available for release from their host material. These constituents will not rinse off the surface and will only be released as the host material corrodes. Characteristic corrosion rates have been determined through corrosion coupon experiments. The corrosion rates define how quickly the constituent will be released and made available for transport. The annual fractional release rate is required in the DUST-MS model. It is calculated by dividing the corrosion rate by the volume-to-surface area ratio for the coupons. Corrosion rates for the SDA have been increased to account for the presence of magnesium chloride in the dust suppressants used on the roads at the SDA. Table 4-20 presents the annual fractional release rates used in the source-release modeling.

4.7.4 Diffusion Coefficient

Volatile organic compounds are released after diffusing through the Rocky Flats Plant sludge waste form. Lowe et al. (2003) measured the release of VOCs from simulated Series 743 sludge and estimated diffusion coefficients from the results. The diffusion coefficients for methylene chloride and 1,4-dioxane were not estimated by Lowe et al. (2003), but for the RI/BRA they were assumed to be similar to carbon tetrachloride. A diffusion coefficient (area per time) is used to specify the outward flux (mass per area per time) of the diffusing VOCs. Table 4-21 presents the diffusion coefficients used in the source-release modeling.

Table 4-20. Annual fractional release rates from corrosion.

Waste Type	Corrosion Rate (in./yr)	Volume-to-Surface-Area Ratio (cm)	Annual Fractional Release Rate (1/yr)[a,b] ABRA	RI/BRA and FS
Activated metal	8.75E-06[c]	1.87[d]	1.19E-05	1.19E-05
Beryllium blocks	0.001[e]	0.96[f]	2.65E-03	2.65E-03
Fuel-like materials	1.18E-3[g]	0.09[h]	NA[i]	3.47E-02
Vycor glass	8.26E-08	6.25E-03	NA[i]	1.30E-05[j]

a. Green shading indicates a change compared to the value used in the Ancillary Basis for Risk Analysis and Preliminary Evaluation of Remedial Alternatives.
b. The annual fractional release rate is the corrosion rate divided by the volume-to-surface area ratio.
c. Adler Flitton et al. (2001).
d. NUREG/CR-4370.
e. Adler Flitton et al. (2001).
f. Calculated based on Advanced Test Reactor geometry.
g. Parsons et al. (2005).
h Calculated based on data in Murray (1994).
i. Waste stream was not modeled in the Ancillary Basis for Risk Analysis.
j. Bechtold (2004).

Table 4-21. Diffusion coefficients.

Contaminant	Diffusion Coefficient (cm^2/s)
Carbon tetrachloride	2.50E-06[a]
Methylene chloride	2.50E-06[b]
Tetrachloroethylene	2.00E-06[a]
Trichloroethylene[c]	4.10E-06[a]
1,4-Dioxane	2.50E-06[b]

a. Lowe et al. (2003).
b. Same as carbon tetrachloride.
c. Simulations for trichloroethylene will be part of the feasibility study; value not yet computed.

4.8 Additional Assumptions

1. Only one drum-failure rate is allowed per simulation. Because 18 source area simulations were performed for each case (i.e., for the base case, the case before Accelerated Retrieval Project retrieval and grouting, and each sensitivity case), it was decided to select the primary isotope for the decay chain and use its drum-failure data to determine the rate for the entire chain. This means, for example, that for the Am-241 decay chain, drum-failure data associated with drums containing Am-241 were used for the daughter products in the Am-241 decay chain. Similarly, failure data associated with drums containing U-238 were used for the daughter products in the U-238 decay chain.

2. Short-lived parents that pose little or no risk on their own were decayed into the daughter inventory. (This same procedure was used previously for the ABRA modeling as well.) For example, Pu-241 was decayed into Am-241 before the modeling.

3. There were no Rocky Flats Plant drums for Group 1 in Pits 7 and 9 (P7&9) in 1967; therefore, no drum fraction was assigned.

4. Because the amount of the other organic contaminants affects relative vapor pressure and mass partitioning into the vapor phase of each organic contaminant, all the organic contaminants are simulated together. For organic contaminants (Group 11), not all contaminants are disposed of each year and not all the contaminants have the same container types each year. Most of the organic contaminants come from Rocky Flats Plant and are in the same drummed waste streams; therefore, the effect of the different container types is expected to be small. The assumption was made on which containers to use in the simulations. Because carbon tetrachloride is the primary risk driver, its containers are used when it is disposed of (primarily the Series 743 sludge from Rocky Flats Plant). When no carbon tetrachloride is disposed of, the container failure is based on the methylene chloride waste streams.

5. In base case simulations, the Pit 4 mass remaining at year 2004, after the Accelerated Retrieval Project, is scaled by the ratio of the initial Pit 4 mass to the Accelerated Retrieval Project targeted waste mass. This assumes that the targeted waste releases at the same rate as the nontargeted waste; therefore, the relative ratio of mass removed remains the same. The ratio is computed for each isotope. Many of the contaminants will have a ratio of 1 because they are not in targeted waste streams.

6. For the base case simulations that include actinides, only the Pit 4 source release needed to be resimulated. The Pit 4 source release was then combined with previous simulations of release for the other source areas, which would not have been affected by the Accelerated Retrieval Project.

7. Half-lives for nonradioactive compounds are set at 1.0E+10 years.

8. Th-232 inventory is in error. There are 1.2 curies reported from one generator (OFF-UBM); however, the total shipment weight is half the calculated weight of the Th-232, if the reported activity is converted to mass. Previous risk assessments showed low risk from Th-232 and its daughter products; therefore, the risk assessment proceeded with the conservative value. If Th-232 or one of its daughter products shows an unacceptable risk (especially with the more conservative biotic uptake modeling), the uncertainty in the inventory should be addressed to determine if any remedial action would be warranted.

9. For the colloidal release for plutonium, the K_d is set to zero and the solubility limit is set to 1E+06.

10. The contaminant mass in the beryllium blocks was not incorporated in WILD when the database was frozen for modeling. The inventory was manually developed in specific locations consistent with Sebo et al. (2005).

11. For C-14, the 1E-05 Ci in Vycor glass is modeled using the surface-wash release for convenience. This is conservative, and the inventory amount is negligible.

12. Tc-99 fuel listed as buried in the Oil Pit in 1966 is modeled as buried in Pit 8 in 1966. There is evidence that during the mid-1960s, oil was disposed of in a separate pit within the SDA and possibly burned. The oil is not the large amount of organic sludge from Rocky Flats but a small

quantity of on-INL Site-generated oil. The location of the Oil Pit is currently unknown. It is not on the official SDA blueprints. Discussions with retired workers indicate that the Oil Pit was likely on the northern side of the SDA between Pit 1 and Pit 3. The inventory in the Oil Pit and the uncertainty in the location are noted here so that potential remedial decisions can take this uncertainty into account.

13. For Group 6, the fraction of Tc-99, I-129, and Cl-36 waste in drums (i.e., the ratio of waste in drums to waste not in drums) is assumed to be the fraction of Tc-99 waste in drums. The fraction of Tc-99 waste in drums is generally less than the fraction of I-129 or Cl-36 waste in drums and is, therefore, conservative.

14. For the biotic modeling, the mass modeled as surface wash is assumed to be immediately available at the time of disposal. This is conservative because no credit is taken for the drums regarding preventing intrusion. The mass modeled by dissolution is treated, as before, as if it is not available for uptake until it is released from the waste form. To simplify the base case simulations, the Pit 4 Accelerated Retrieval Project mass after retrieval is input into the model in 2004 and is available from that time. This does not account for the total initial mass; but because no credit is taken for the containers, this is a minor “nonconservativism” in the overall conservative modeling.

15. Projections for the Low-Level Waste (LLW) pit, for operations through 2009, are all assumed to have been emplaced in 2000.

5. REMEDIAL INVESTIGATION RESULTS

This section presents the results of the simulations for the remedial investigation and feasibility study (RI/FS), including the sensitivity simulations.

5.1 Base Case

This section presents results for the base-case simulations. The base case for the draft Remedial Investigation and Baseline Risk Assessment (RI/BRA)[b] includes grouting the beryllium blocks and Accelerated Retrieval Project retrievals. Figures 5-1 through 6-7 show both the release rate and cumulative release of contaminants for the relevant simulations groups. Figure 5-1 shows the release for the Am-241 decay chain. The Am-241 is limited by the solubility and the partitioning into the water phase for a period of nearly 2,000 years. After that time, Am-241 decays as seen in the downward slope of the release curve. The Np-237 shows an increase in release for over 1,000 years. This is due to the ingrowth of the Np-237 from the decay of the Am-241. Figure 5-2 shows the cumulative release for Group 1. Only about 100 of the more than 230,000 curies of Am-241 disposed of actually releases. The remaining curies decay to Np-237 before release. Only 0.14 curies of Np-237 are disposed of, but nearly 46 curies are released.

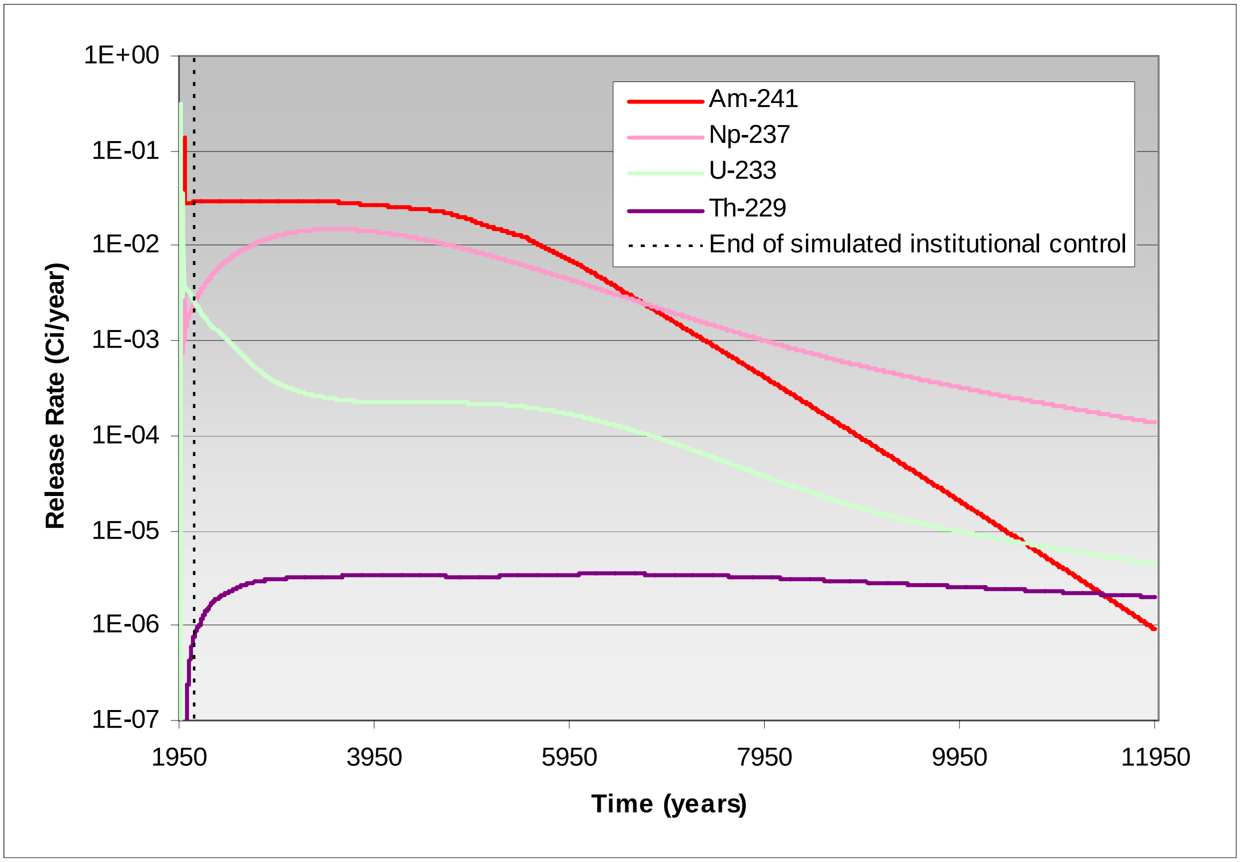


Figure 5-1. Release of Group 1 contaminants.

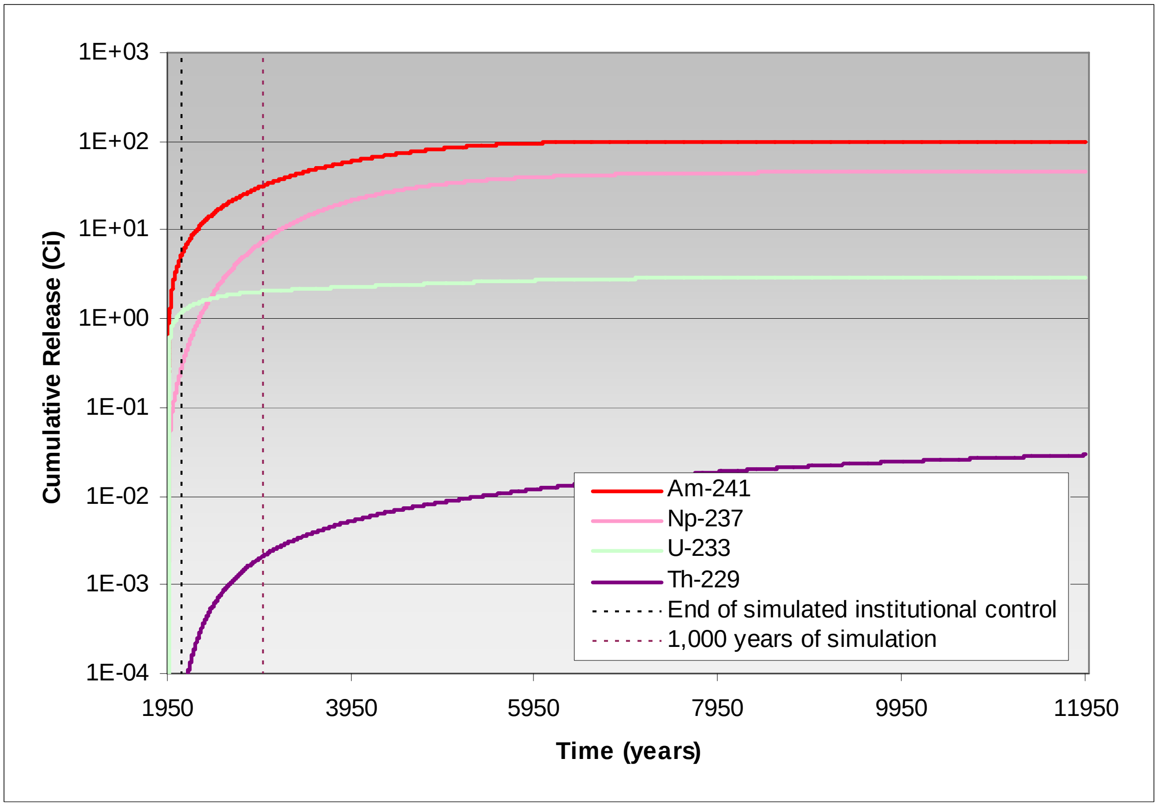


Figure 5-2. Cumulative release of Group 1 contaminants.

Figure 5-3 presents the release of Group 2 contaminants. Initially, Pu-239 releases quickly because of the simulated colloidal fraction. Then, it continues to release slowly, controlled by the partitioning into the water. The U-235 release is nearly constant for the entire period. This is due to the solubility limit of uranium in the water. The Pa-231 is due to decay and ingrowth from the U-235; therefore, the curves are nearly identical. The odd appearance of Ac-227 is likely due to numerical noise because of its short half-life. Additional work will be done for the feasibility study to determine the exact reason for the shape of the curve. Figure 5-4 shows the cumulative release of Group 2. The effect of the colloidal plutonium is clearly visible on the initial rapid release and then slow release later. The U-235 release is constant over time, but the cumulative release looks curved because of the log scale used to show the large changes in totals.

Figure 5-5 shows the release of the Group 3 contaminants. Initially, Pu-240 releases rapidly due to the colloidal fraction, then releases slowly over time. The U-236 releases gradually over time, controlled by the distribution coefficient. Figure 5-6 shows the cumulative release of Group 3. The total release from Pu-240 is nearly all from the colloidal fraction. The Th-232 and Ra-228 curves parallel the U-236 curve because they are mostly generated from the decay of the U-236.

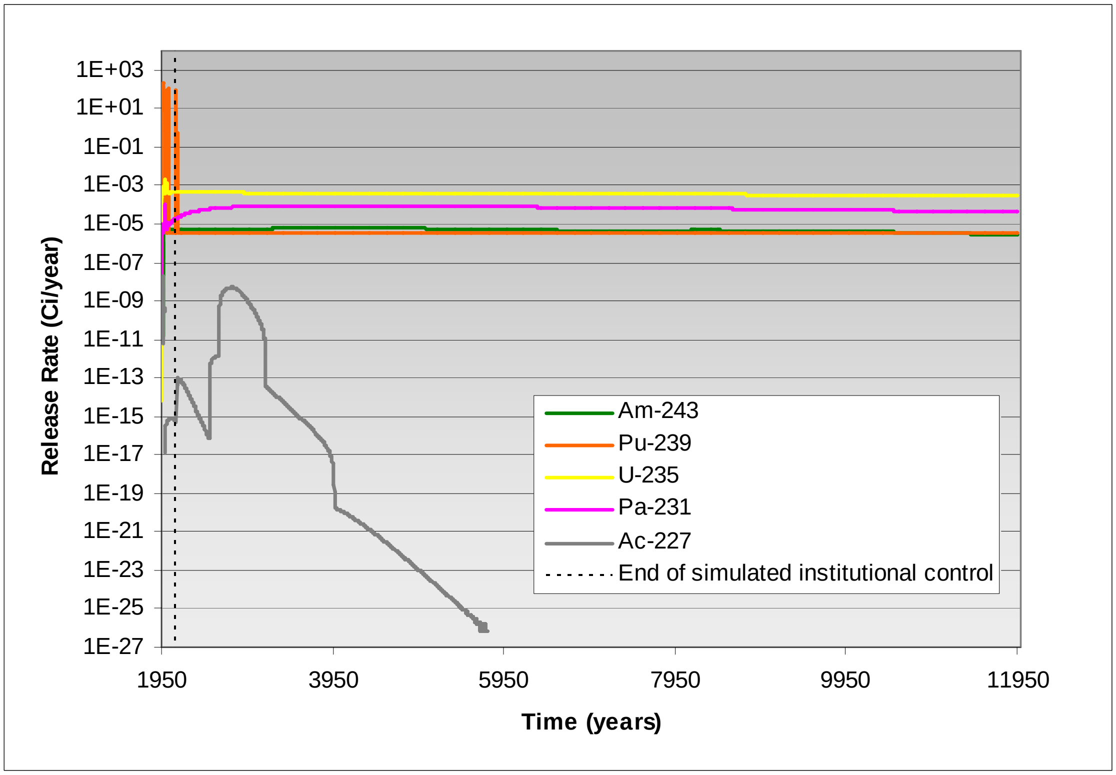


Figure 5-3. Release of Group 2 contaminants.

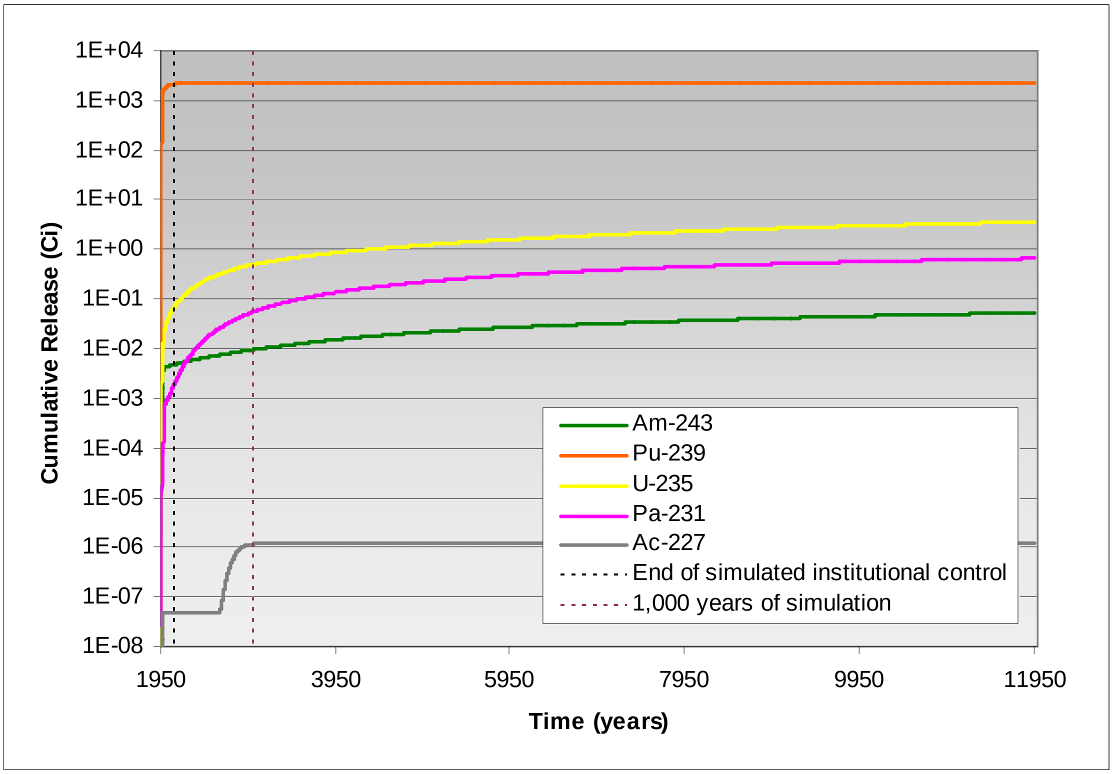


Figure 5-4. Cumulative release of Group 2 contaminants.

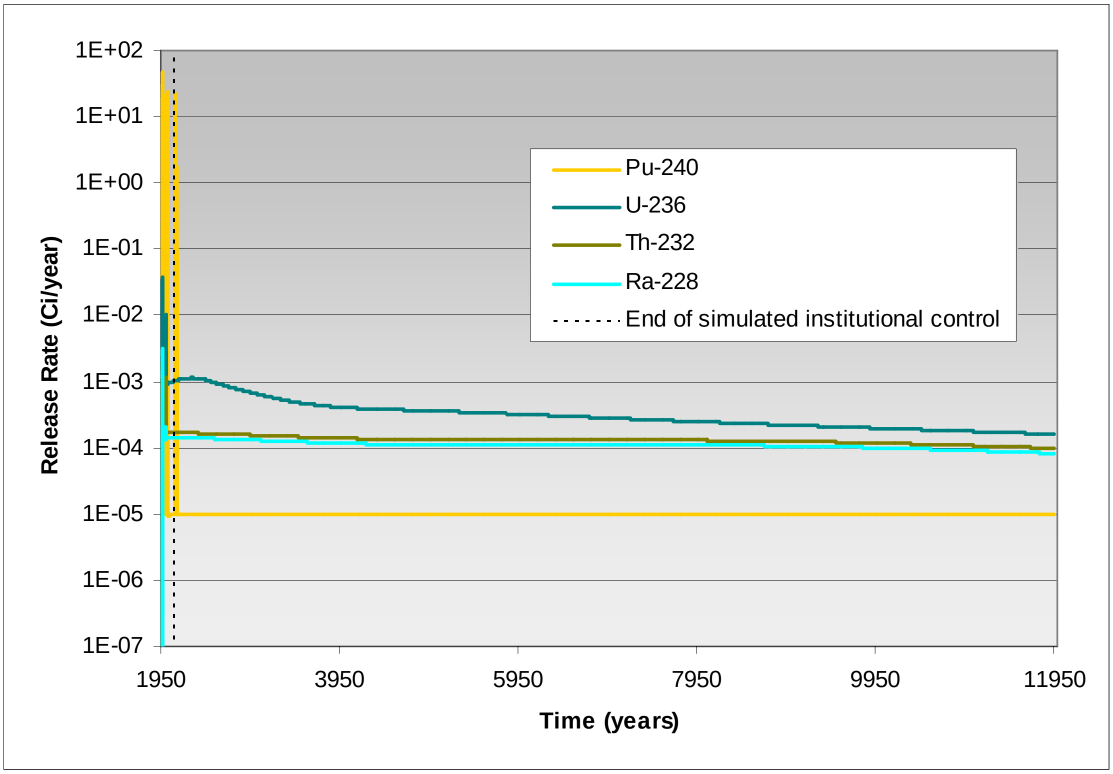


Figure 5-5. Release of Group 3 contaminants.

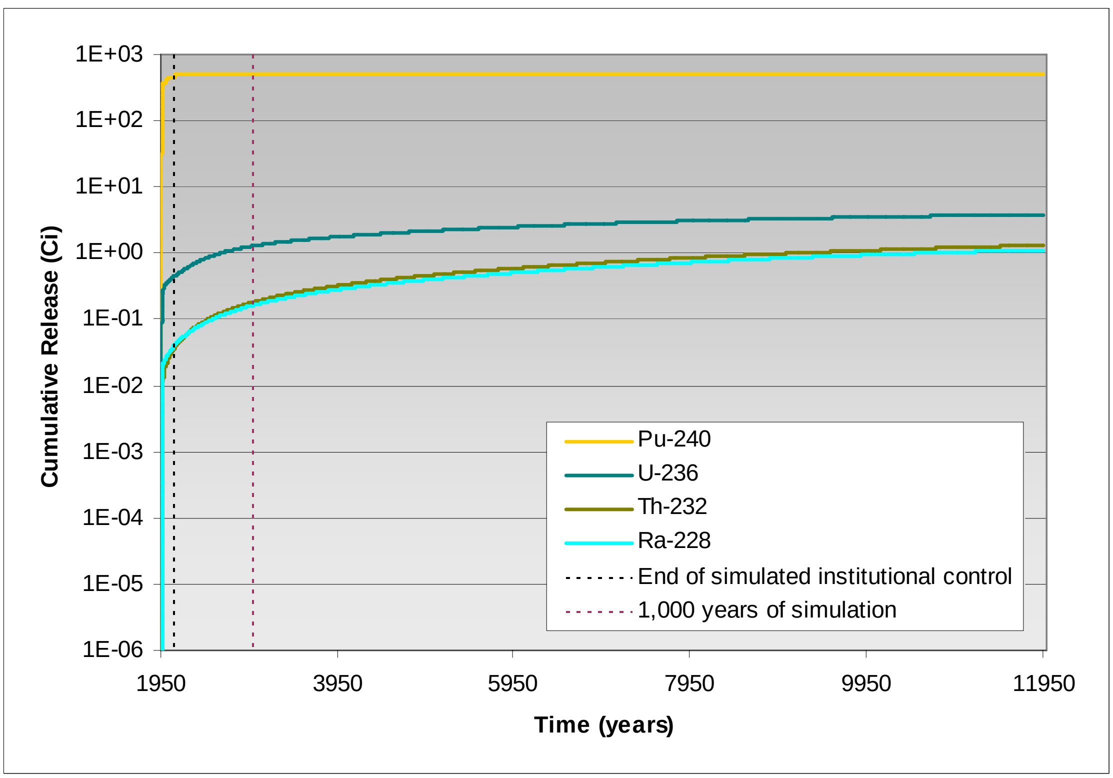


Figure 5-6. Cumulative release of Group 3 contaminants.

Figure 5-7 shows the release of the Group 4 contaminants as a function of time. The Pu-238 has a short half-life (87.7 yrs); therefore, the release rapidly decreases from the decay. The release of the U-234 builds gradually over time as this daughter is produced from the decay of the Pu-238. Because the only U-234 is from ingrowth, the release gradually decreases as mass is released. Conversely, the Th-230, Ra-226, and Pb-210 releases increase gradually over time as these daughter isotopes are produced. Figure 5-8 shows the cumulative release of the Group 5 contaminants. Because of the high K_d, the cumulative release of Pu-238 is only 0.2 curies. The 0.7 curies of U-234 are all from the decay of the Pu-238, as is the Th-230, Ra-226, and Pb-210.

Figure 5-9 shows the release of the Group 5 contaminants as a function of time. Group 5 contaminants consist of the U-238 decay chain. The release of both U-238 and U-234 is limited by the solubility of uranium. That is why both release curves are nearly constant for the simulation period. The mass released from the U-238 is larger because it is a larger fraction of the total initial uranium mass. The cumulative release of the Group 5 contaminants is shown in Figure 5-10. The cumulative release of U-238 and U-234 is linear with time. It appears to curve because of the log scale used to show the values that change by orders of magnitude.

Figure 5-11 shows the release of the Group 6 contaminants as a function of time. Group 6 contaminants consist of Tc-99, I-129, and Cl-36. The release of Tc-99 is dominated in the early years by the surface-wash, resin, and fuel waste streams. The long-term release gradually goes to the activated metal release. The I-129 release is similar to the Tc-99 release. The Cl-36 is dominated in the early years by the surface-wash and resin waste streams. In the intermediate period, the corrosion of beryllium controls the total release, and eventually the activated metal release is all that remains. Figure 5-12 shows the cumulative release of the Group 6 contaminants as a function of time. It shows the high initial release of all three contaminants with a gradual increase in the long-term cumulative release due to the slow release from activated metal.

Figure 5-13 shows the release of the Group 8 contaminants as a function of time. Group 8 consists of C-14. Initially, the release is dominated by the surface-wash and resin waste streams. In the intermediate period, the beryllium controls the release. Eventually, only the activated metal release remains. The cumulative release of C-14 is shown in Figure 5-14. Much of the C-14 is in activated metal. Only 21 of the 731 curies release in the 10,000 years.

Figure 5-15 shows the release of the Group 10 contaminants as a function of time. Group 10 consists of nitrate. The release of nitrate is controlled by the drum failure used in the model. This is because the distribution coefficient is zero, and any mass available for release is immediately released. The spikes on the release curve are due to large numbers of drums being dumped and some failing at disposal. Then, there is a narrow “hump” in the release curve for the Gaussian distribution of dumped drums. Then, the wider “hump” for the Gaussian distribution of the stacked drums can be seen. The spike at the end of the release curve (year 2030) is due to the error in DUST-MS (See Section 6.1). Figure 5-16 shows the cumulative release. All of the 4.56E+08 grams of nitrate disposed of are released.

Figure 5-17 shows the release of the Group 11 contaminants as a function of time. Group 11 consists of the volatile organic compounds (VOCs): carbon tetrachloride, methylene chloride, and percloroethylene. The release of these contaminants from the waste is via diffusion, which is rapid; therefore, similar to the nitrate, the release is controlled by the drum-failure rate. Figure 5-18 shows the cumulative release of the Group 11 contaminants. All of the disposed mass is released by the end of the institutional control period.

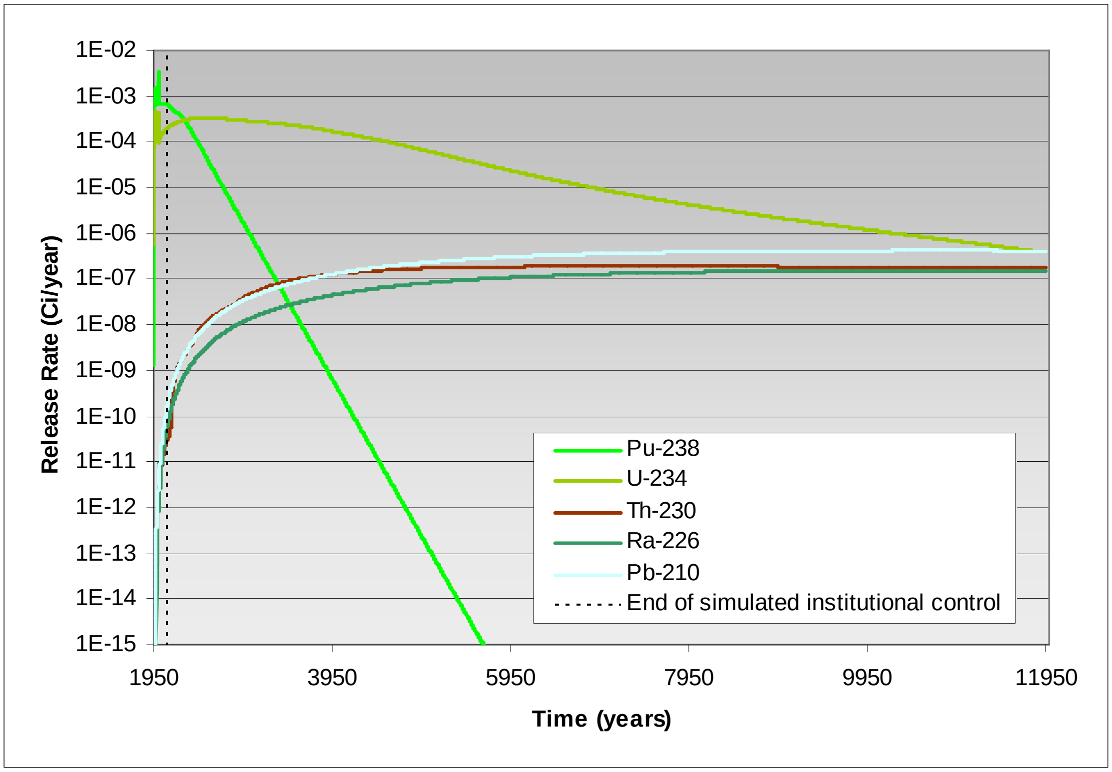


Figure 5-7. Release of Group 4 contaminants.

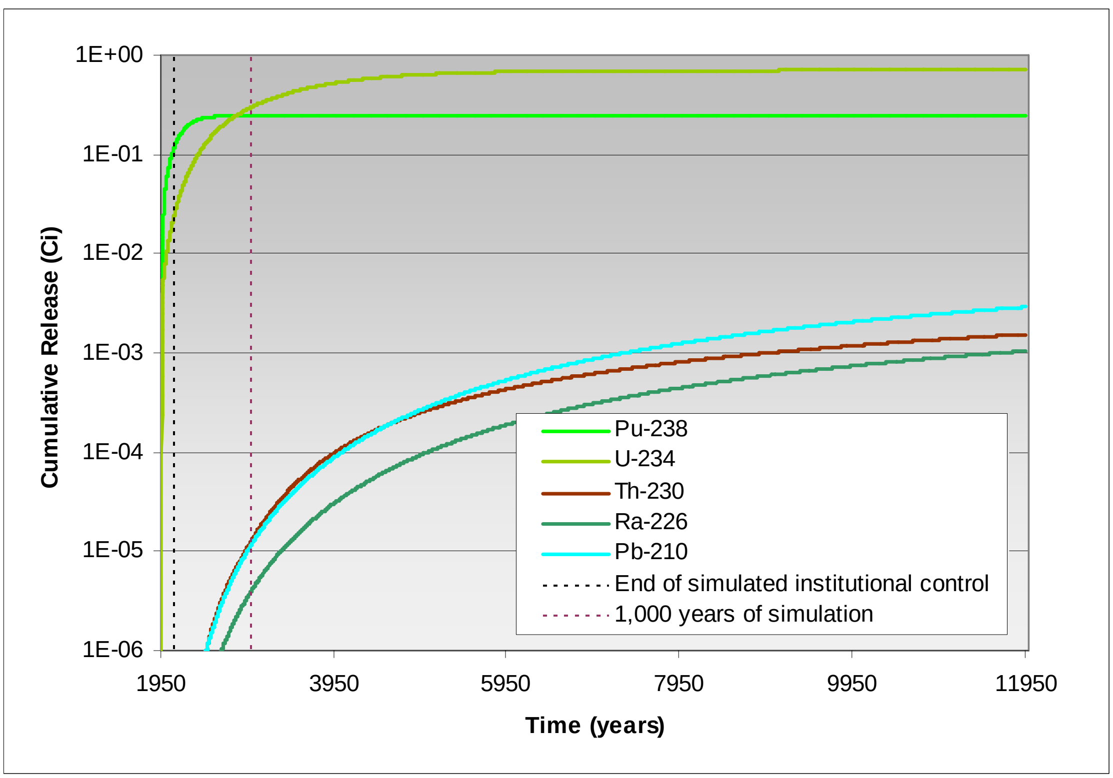


Figure 5-8. Cumulative release of Group 4 contaminants.

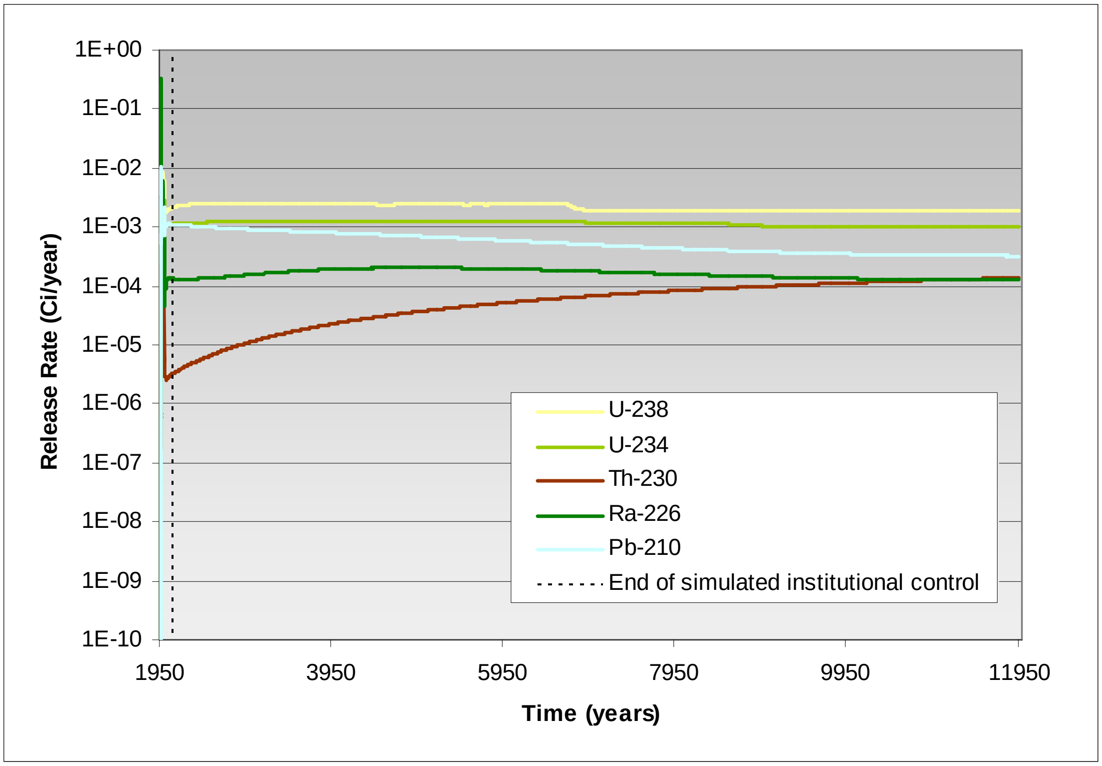


Figure 5-9. Release of Group 5 contaminants.

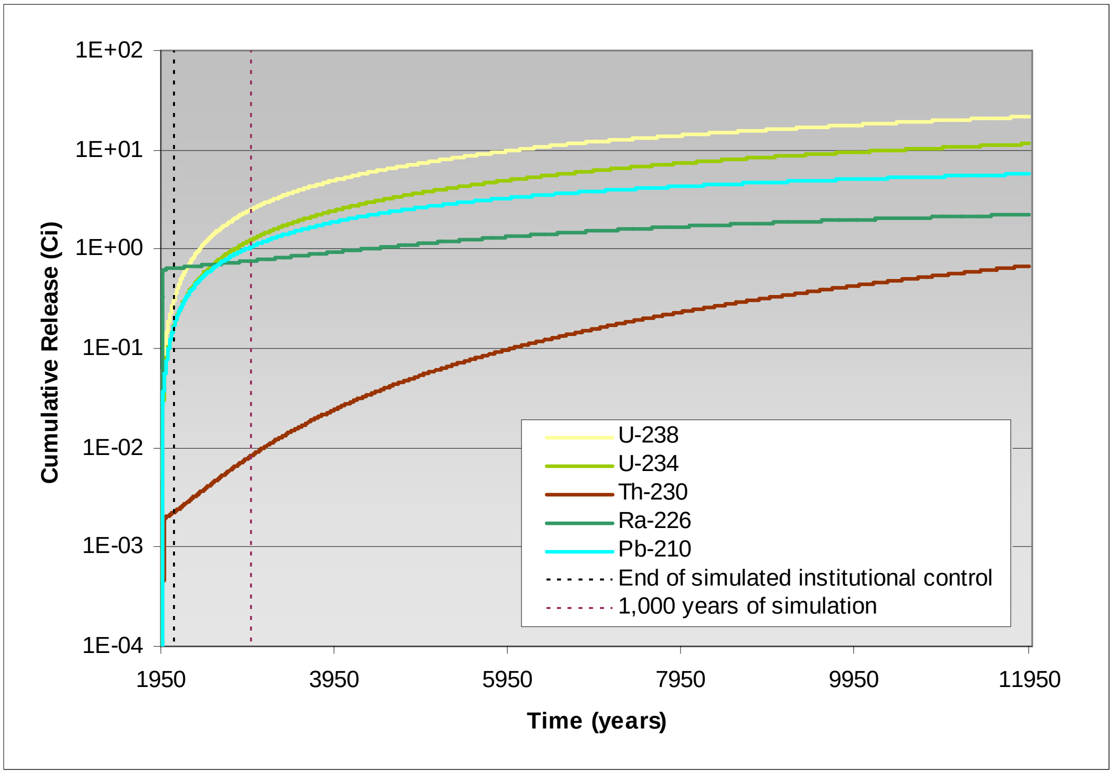


Figure 5-10. Cumulative release of Group 5 contaminants.

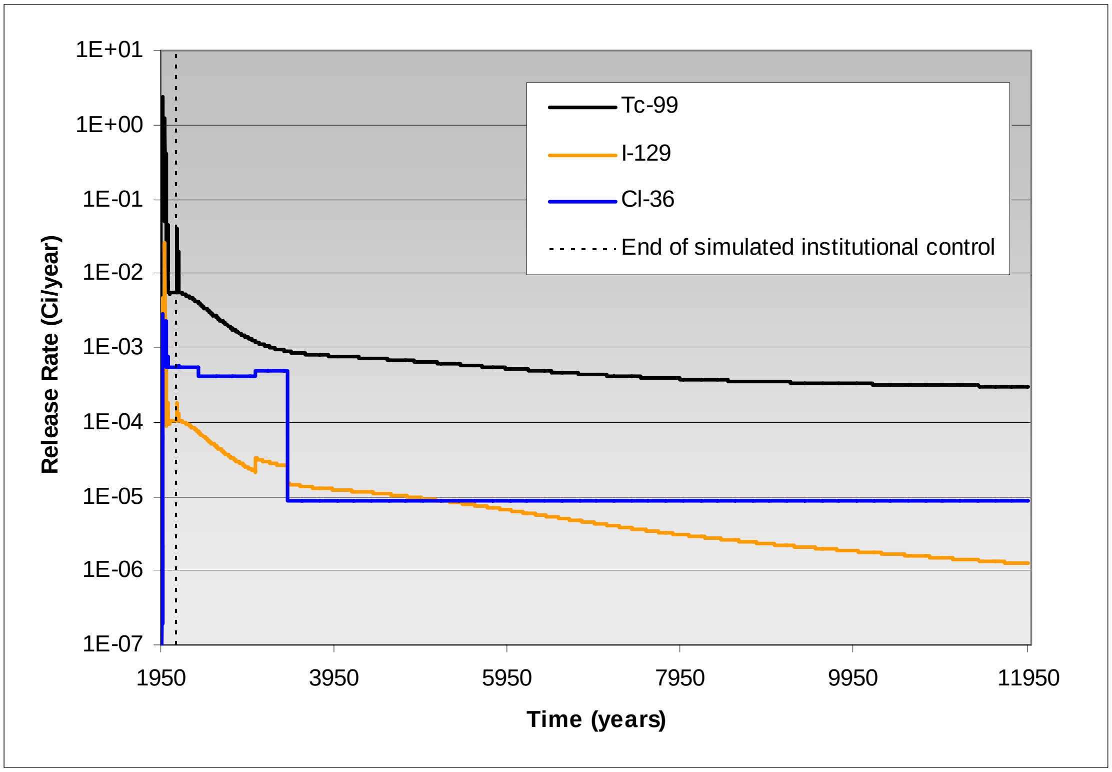


Figure 5-11. Release of Group 6 contaminants.

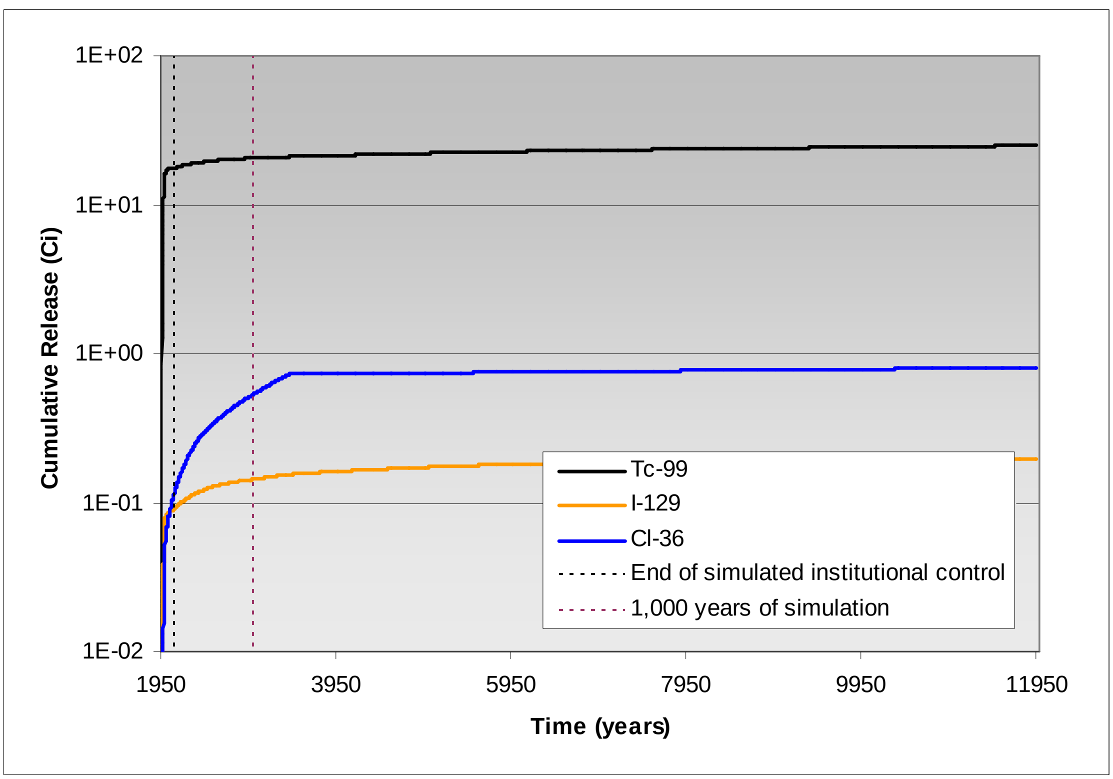


Figure 5-12. Cumulative release of Group 6 contaminants.

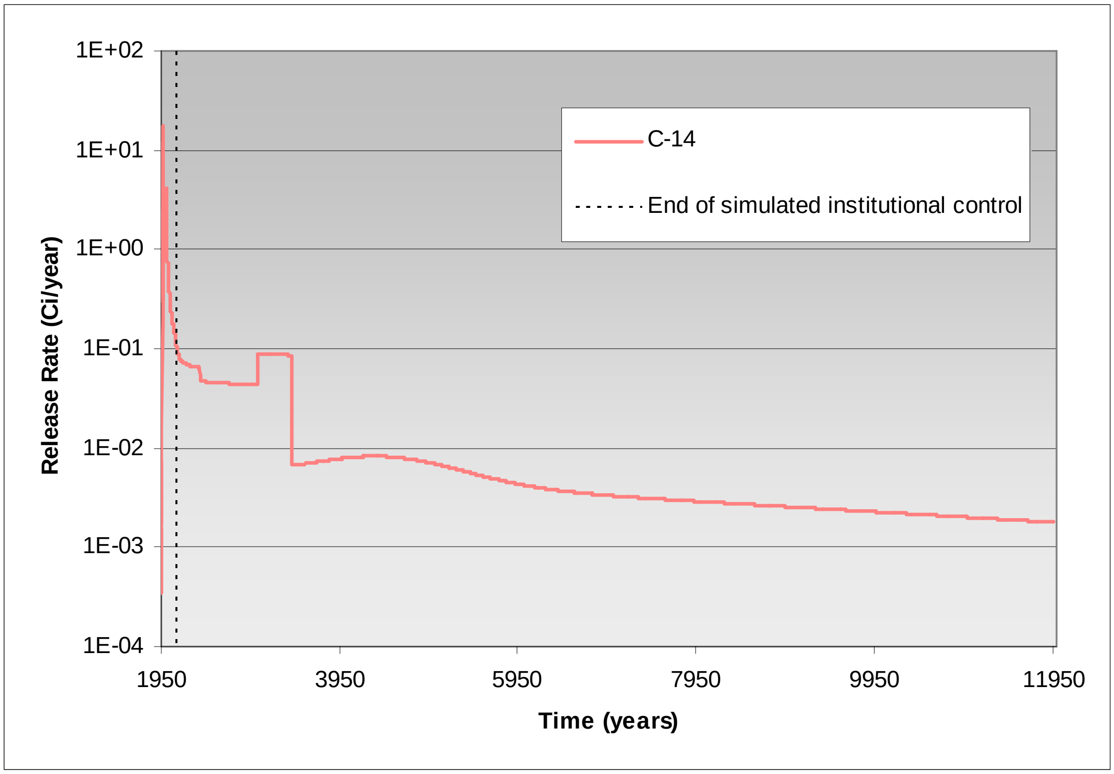


Figure 5-13. Release of Group 8 contaminants.

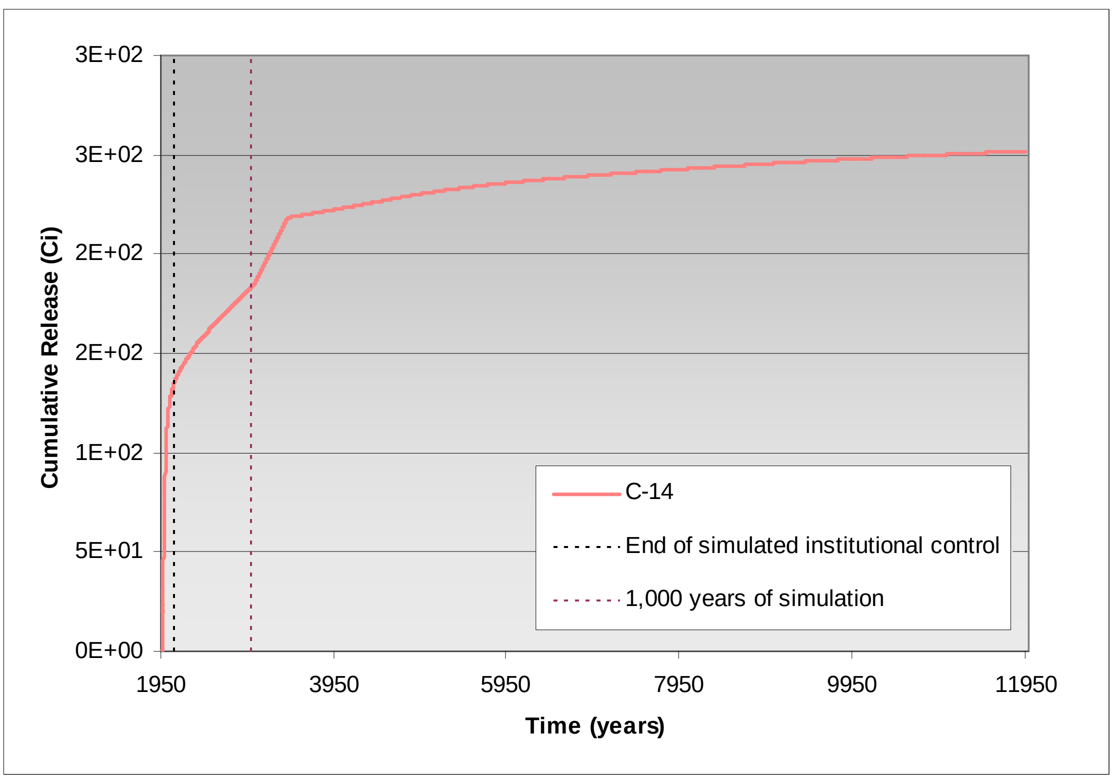


Figure 5-14. Cumulative release of Group 8 contaminants.

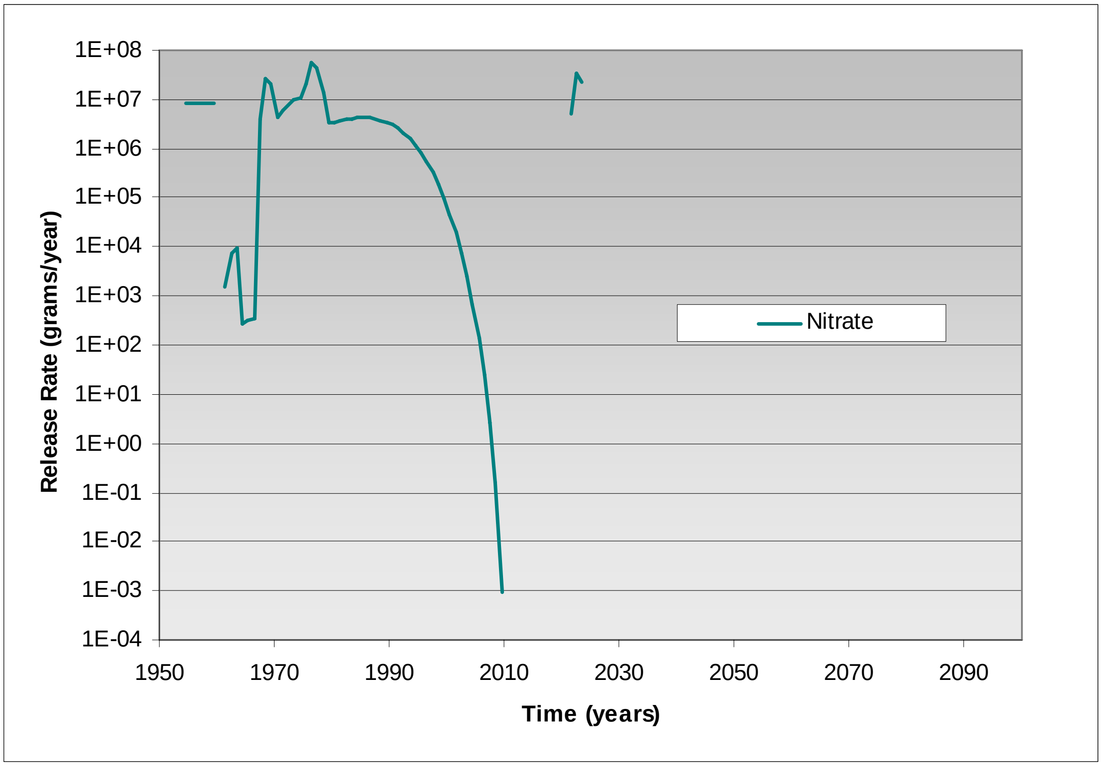


Figure 5-15. Release of Group 10 contaminants.

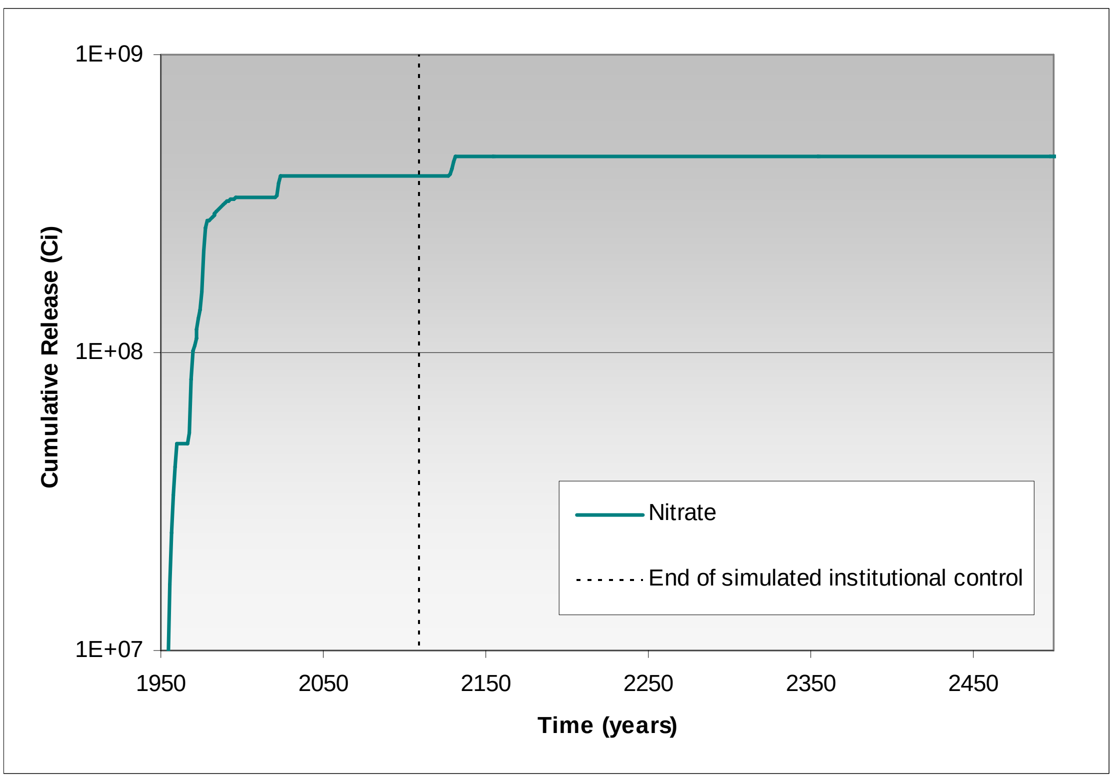


Figure 5-16. Cumulative release of Group 10 contaminants.

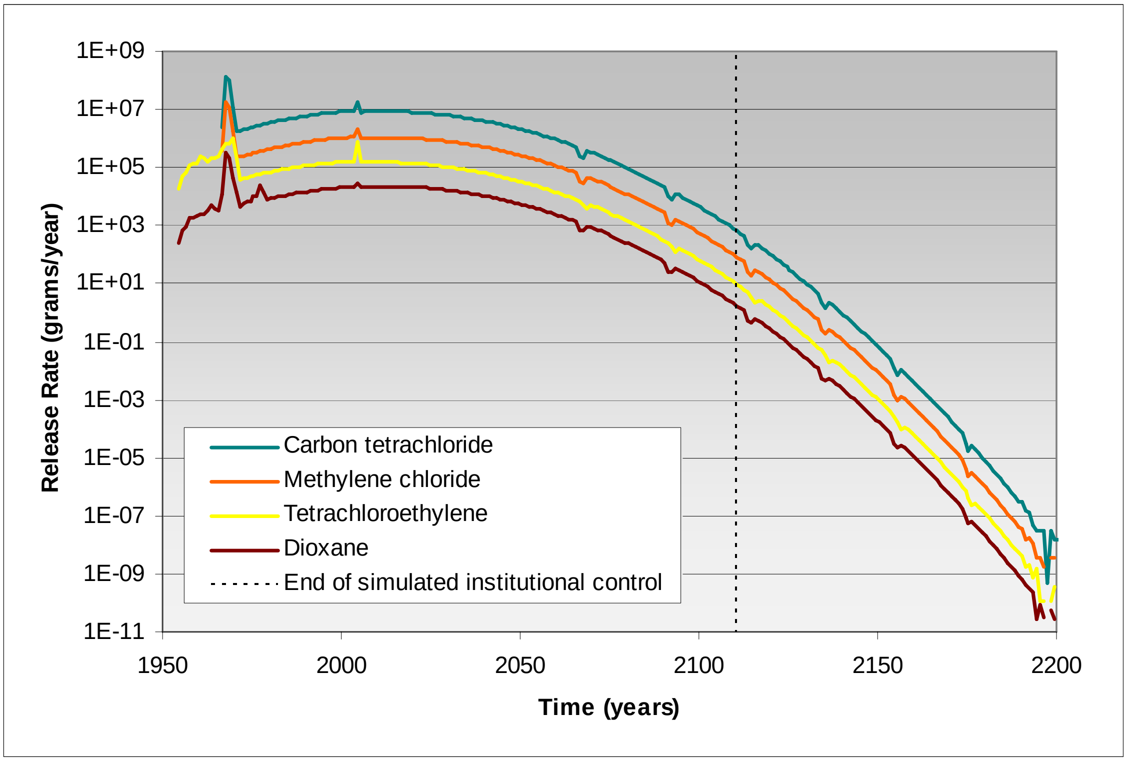


Figure 5-17. Release of Group 11 contaminants.

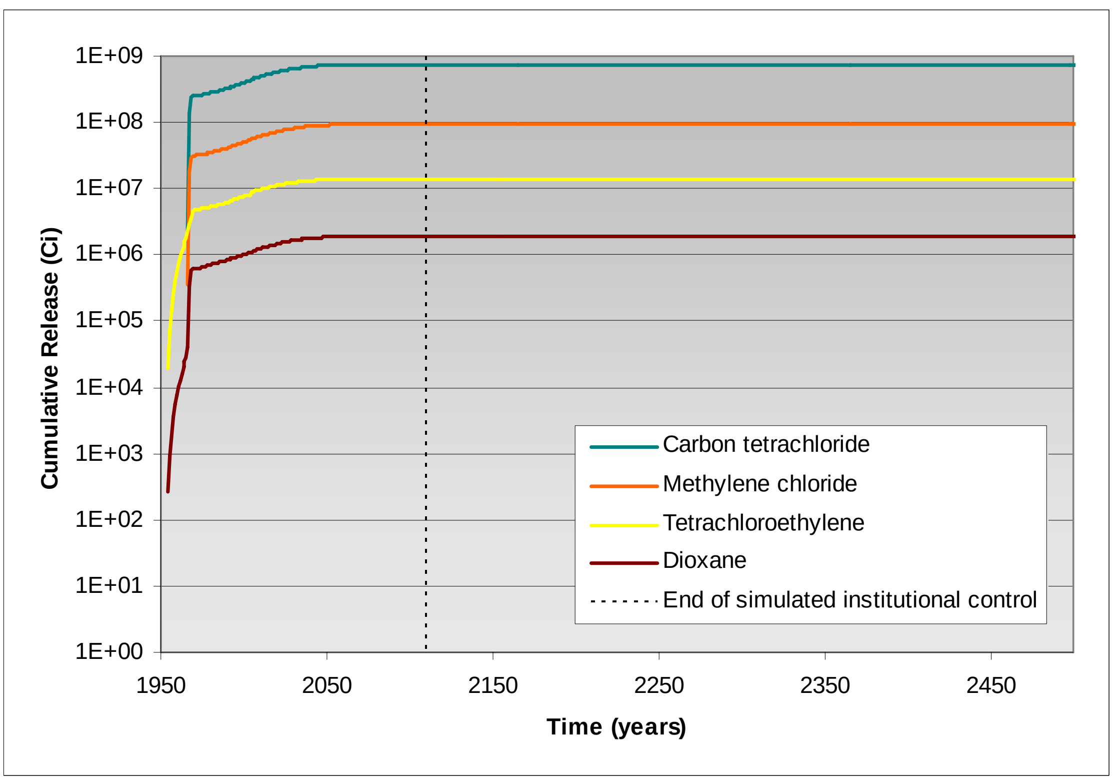


Figure 5-18. Cumulative release of Group 11 contaminants.

5.2 Remedial Investigation Sensitivity Cases

The remedial investigation examines the risk if the site is left alone. This is the "no action alternative." As with any assessment, there is uncertainty in the predicted risk. Several sensitivity cases were defined to address the magnitude of the uncertainty. These cases addressed the upper-bound inventory, changes in the infiltration rate, and not retrieving in Pit 4 or grouting the beryllium blocks. The results of these sensitivity cases are discussed in the following subsection. The Ancillary Basis for Risk Analysis (ABRA) (Holdren et al. 2002) and Interim Risk Assessment (IRA) (Becker et al. 1998) had additional sensitivity cases, but the impact on the results was insignificant, and they were not examined as part of the Remedial Investigation Baseline Risk Assessment.[b] The remedial investigation focused on those parameters that had changed substantially since the previous assessments. The release plots for each contaminant are provided in Appendix C. Plots showing the comparison between the sensitivity case and the base case are provided in this section.

5.2.1 Upper-Bound Inventory

The inventory for many of the radionuclides addressed has changed substantially since the ABRA. To quantify the uncertainty due to not knowing exactly what was buried in the Subsurface Disposal Area (SDA), the upper-bound inventory for each isotope was simulated. The difference between the results for the base case and the upper-bound case provides an estimated measure of the potential error in the calculated risk. For the plutonium from the Rocky Flats Plant, the mobile colloidal fraction was also increased in these simulations. Table 5-1 contains the best-estimate (base case) and upper-bound inventories for each contaminant. Figure 5-19 shows the release from the upper-bound inventory for U-234 and U-238, and Figure 5-20 shows the cumulative release from the upper bound-inventory for U-234 and U-238. Figure 5-21 shows the release from the upper-bound inventory for C-14 for comparison, and Figure 5-22 shows the cumulative release of C-14. The full set of results is included in Appendix C.

Table 5-1. Comparison of best-estimate and upper-bound inventories.

Group	Contaminant	Best-estimate[a]	Upper-bound[a]
1	Am-241	2.43E+05	3.24E+05
	Np-237	1.41E-01	2.88E-01
	U-233	2.12E+00	2.66E+00
	Th-229	7.14E-06	7.33E-06
2	Am-243	1.18E-01	1.65E-01
	Pu-239 (colloidal)	2.33E+03	4.10E+03
	Pu-239	6.18E+04	8.47E+04
	U-235	4.88E+00	7.06E+00
	Pa-231	8.61E-04	5.19E-03
	Ac-227	4.29E-06	1.11E-05
3	Pu-240 (colloidal)	5.22E+02	9.19E+02
	Pu-240	1.41E+04	2.18E+04
	U-236	1.45E+00	2.39E+00
	Th-232	3.51E+00	7.15E+00
	Ra-228	3.66E-05	6.99E-05

Table 5-1. (continued).

Group	Contaminant	Best-estimate[a]	Upper-bound[a]
4	Pu-238	2.08E+03	2.84E+03
5	U-238	1.48E+02	2.52E+02
	U-234	6.26E+01	9.52E+01
	Th-230	5.77E-02	7.49E-02
	Ra-226	6.51E+01	8.72E+01
	Pb-210	5.59E-07	5.99E-05
6	Tc-99	4.29E+01	7.59E+01
	I-129	1.85E-01	3.21E-01
	Cl-36	1.64E+00	2.62E+00
7	Not used	NA	NA
8	C-14	7.38E+02	1.09E+03
9	Nb-94	1.28E+02	2.14E+02
	Sr-90	1.32E+05	2.29E+05
10	Nitrate	4.56E+08	6.35E+08
11	Carbon tetrachloride	7.86E+08	9.61E+08
	Methylene chloride	1.41E+07	1.55E+07
	Tetrachloroethylene	9.87E+07	2.70E+08
	Trichloroethylene[b]	9.72E+07	1.13E+08
	1,4-Dioxane	1.95E+06	6.26E+06

a. Units: Curies for radionuclides; grams for volatile organic compounds and inorganics (nonradionuclides).
b. Simulations for trichloroethylene will be part of the feasibility study; value not yet computed.
NA = not applicable

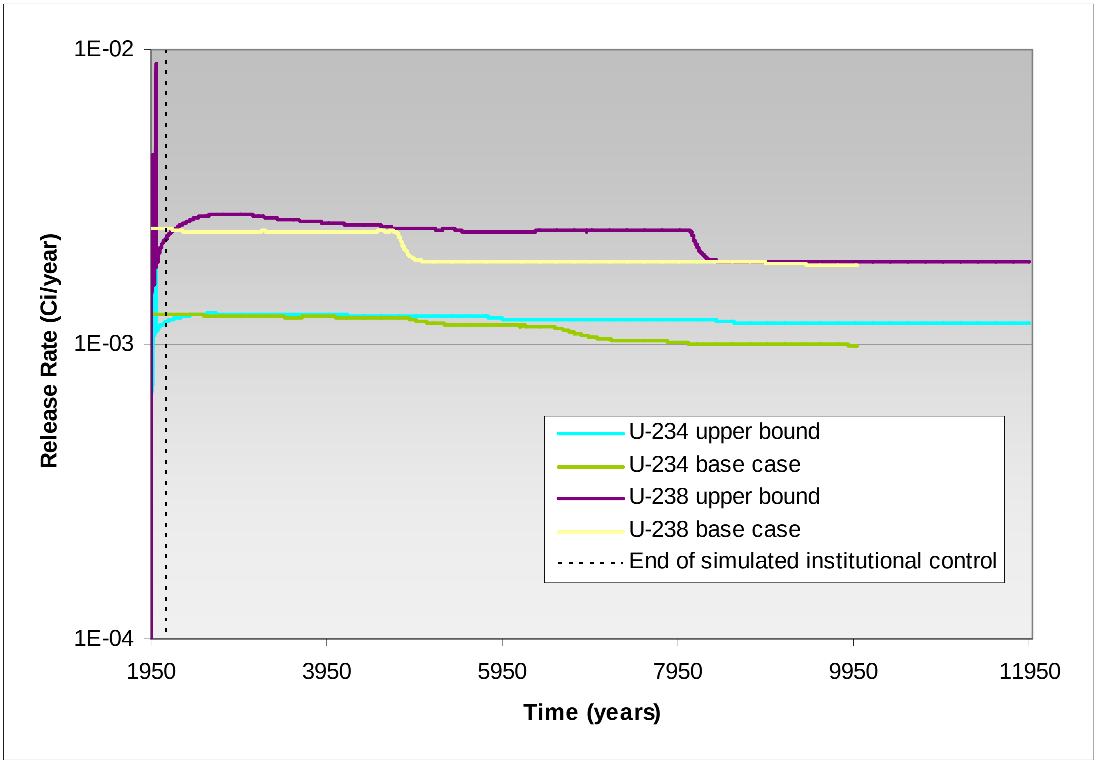


Figure 5-19. Comparison of uranium-238 and -234 releases for upper-bound inventory and base-case inventory.

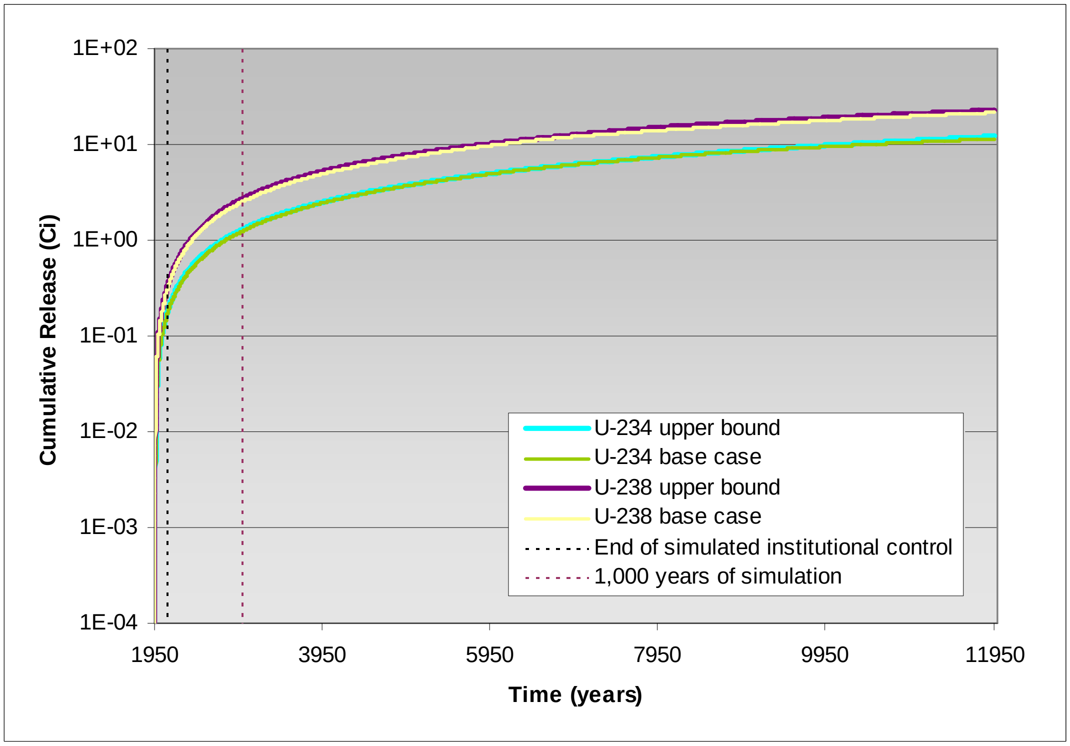


Figure 5-20. Comparison of cumulative releases of uranium-238 and -234 for upper-bound inventory and base-case inventory.

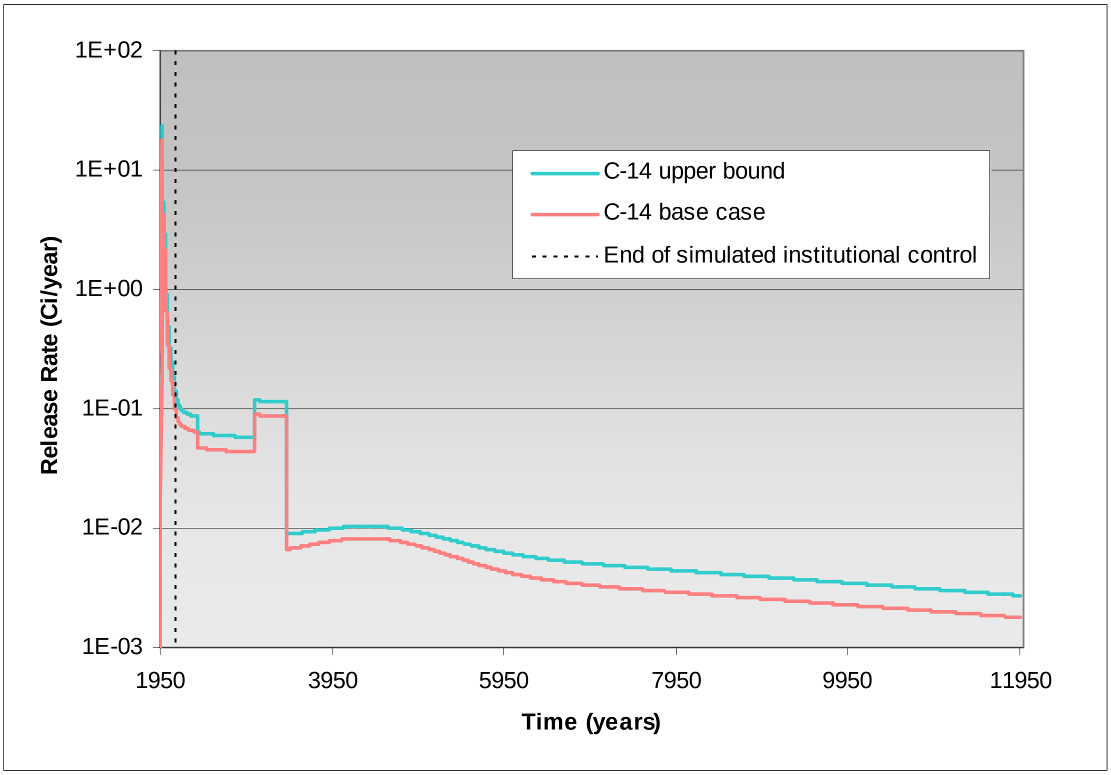


Figure 5-21. Comparison of carbon-14 release for base-case and upper-bound inventory.

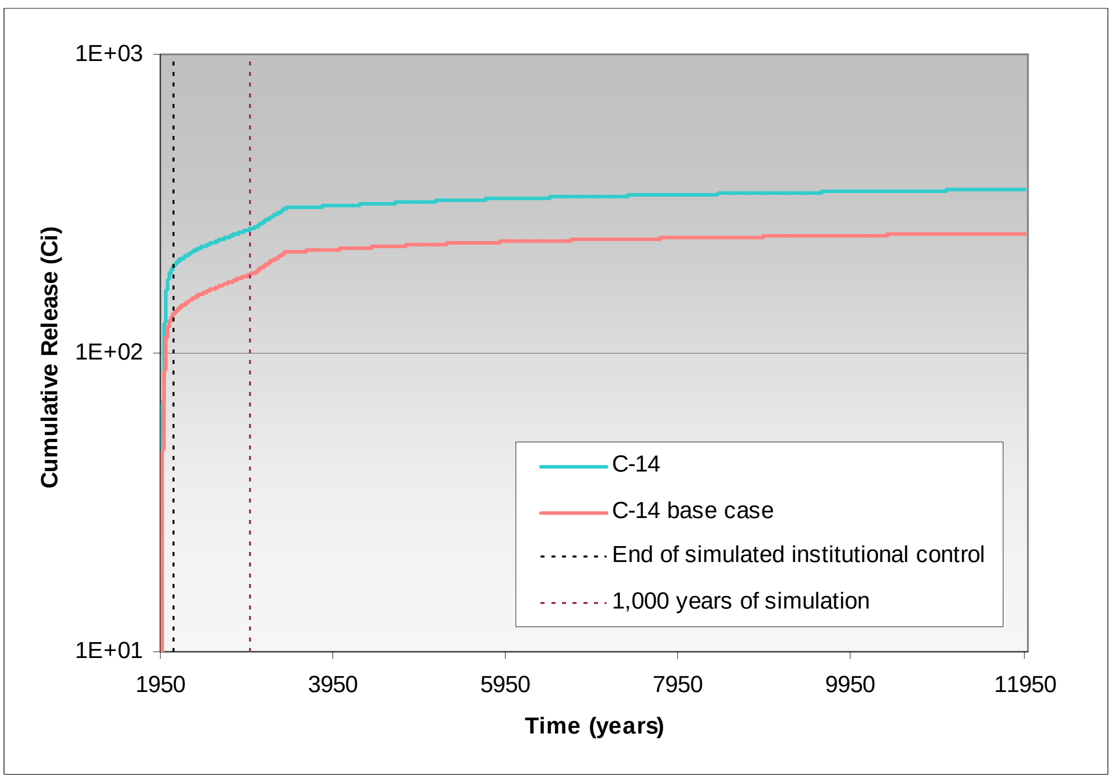


Figure 5-22. Comparison of carbon-14 cumulative release for base-case and upper-bound inventory.

5.2.2 Infiltration Sensitivity

Infiltration is an important driving force in transporting contaminants to the aquifer. A set of sensitivity simulations was performed to address the effect of changing the infiltration on the risk results. A bounding case that assumes the infiltration rate is equal to the average precipitation rate is simulated in addition to examining changes in the background infiltration rate outside the SDA. Caps and other means to reduce infiltration through the waste are addressed as part of the feasibility study.

An upper-bound infiltration case, with a high infiltration rate of 23 cm/yr (9 in./yr), was simulated. Plots showing the release from the "high infiltration" sensitivity case are presented in Figures 5-23, 5-24, 5-25, and 5-26. Comparisons with the base case for selected contaminants are presented. The contaminants selected are C-14 and U-238. They are shown because they represent a contaminant with a mix of release mechanisms (C-14) and a contaminant that is released via surface wash (U-238). The additional water could greatly affect the release of the uranium because of it being solubility limited. Figure 5-23 shows the effect of the high infiltration on C-14 release. The initial release is from the surface-wash waste streams. The higher infiltration makes the initial peak release higher. After the initial peak, the release is controlled by the beryllium corrosion from the base case. The high infiltration case shows a higher release and a "hump" in the release curve that occurs much later (around year 2750) in the base case. This is due to release from resins. Once the high infiltration release from resins is over, the curves match for a period (approximately year 3050 to year 3450). This is the release from beryllium blocks. The effect of the higher infiltration on the corrosion of the activated metal is unknown; therefore, the release was simulated the same from those waste forms. As Figure 5-23 shows, in the long term, both release curves reach the same value, which is controlled by the release from activated stainless steel (greater than year 8000). The cumulative release of C-14 is shown in Figure 5-24. The release curves differ very little from the infiltration rates. Figure 5-25 compares the U-238 and U-234 release with the higher infiltration. Uranium is solubility limited; therefore, the higher infiltration means more mass can be released. This is evident in the figure. The cumulative release shown in Figure 5-26 shows the impact on total mass released with the higher infiltration. The complete set of release plots are in Appendix C.

5.2.3 No Retrieval and No Grout

The no-retrieval and no-grout sensitivity case addresses the impact if the current remediation is not successful. Because the grouting of the beryllium block is completed, this case would address what the impact would be if the grout failed. Figures 5-27 through 5-32 show the release of the various contaminants without the retrieval or grouting of the beryllium blocks. Figure 5-27 compares the release of C-14 with and without the grouting. Carbon-14 is not targeted for retrieval; therefore, the Accelerated Retrieval Project retrieval does not affect the results. As the figure shows, the release without the grouting stays higher longer than the base case with the grouting. The grouting reduces the release and causes it to occur over a longer period. The jump in the base-case results occurs when the grout is assumed to fail after 1,038 years (calendar year 3042). Figure 5-28 shows the effect of the grouting on the cumulative release. Figure 5-29 shows the comparison of the VOC release rate, and Figure 5-30 shows the comparison of the VOC cumulative release with and without the retrieval. The difference between the curves is negligible. Figure 5-31 compares Am-241 and Np-237 release for the no-retrieval and no-grout sensitivity case. These contaminants were chosen to show the range of impact of the retrieval or grouting. The cumulative release of Am-241 and Np-237 is shown in Figure 5-32. Very little difference can be seen between the cases. The full set of release plots for this case is included in Appendix C.

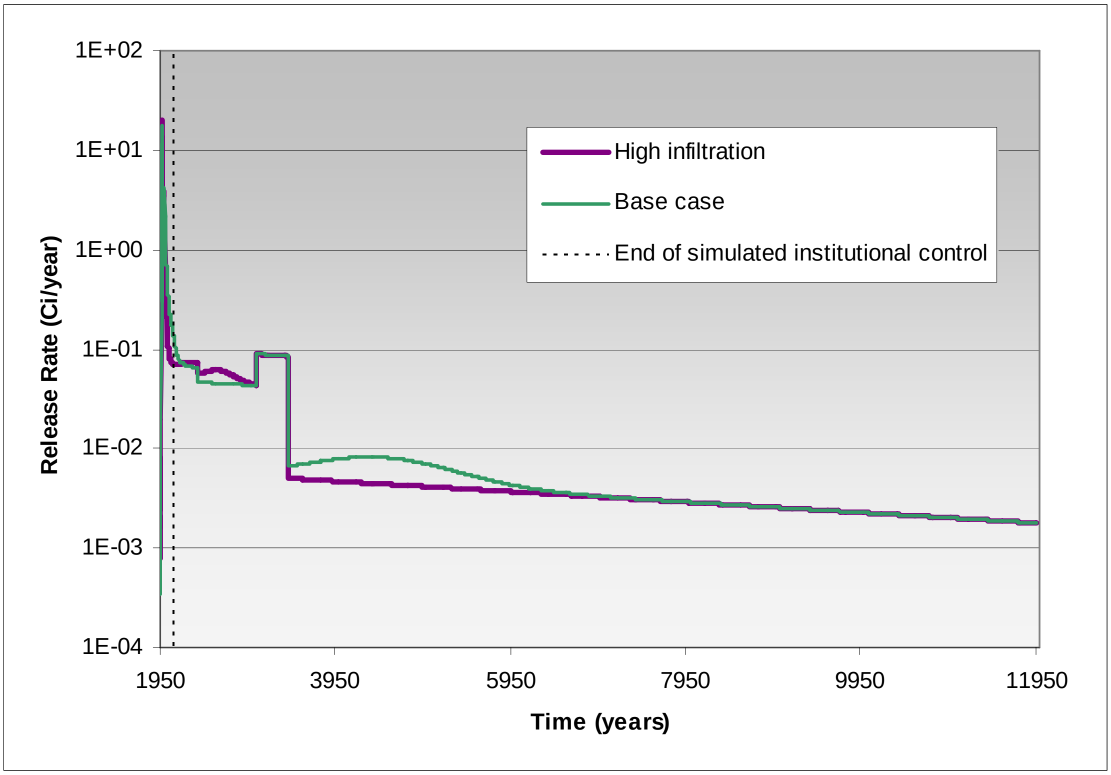


Figure 5-23. Comparison of carbon-14 release for the high-infiltration sensitivity case.

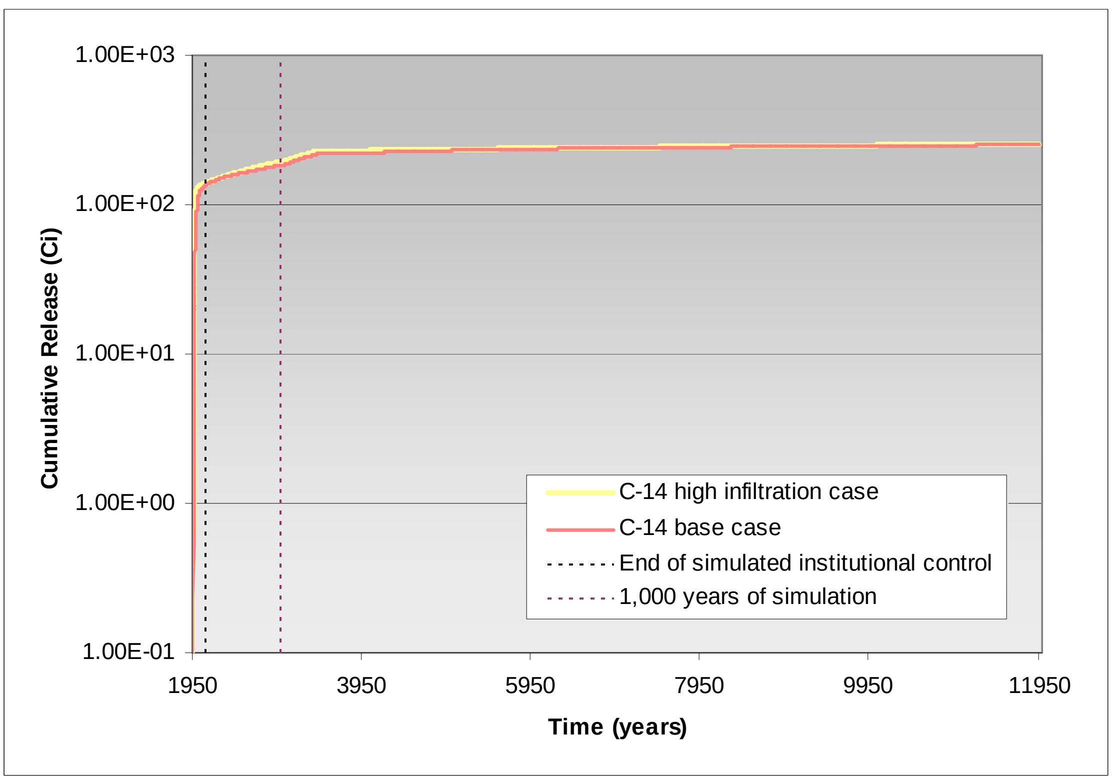


Figure 5-24. Comparison of carbon-14 cumulative release for the high-infiltration sensitivity case.

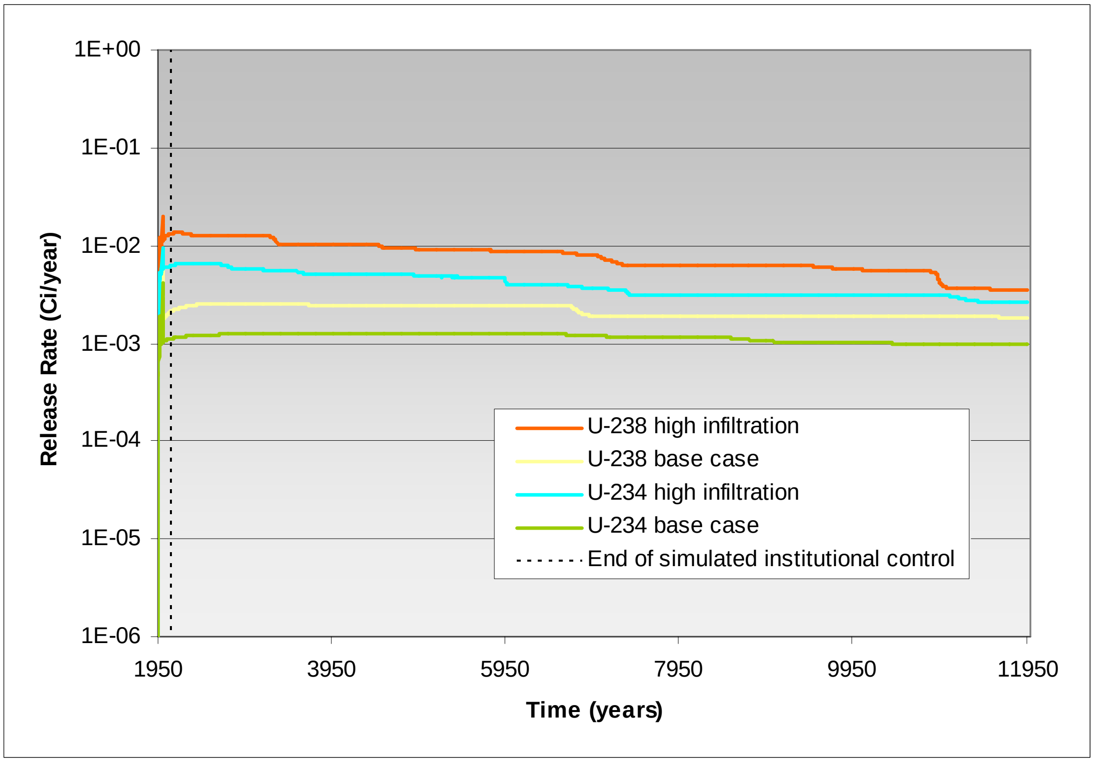


Figure 5-25. Comparison of uranium-238 and -234 releases for the high-infiltration sensitivity case.

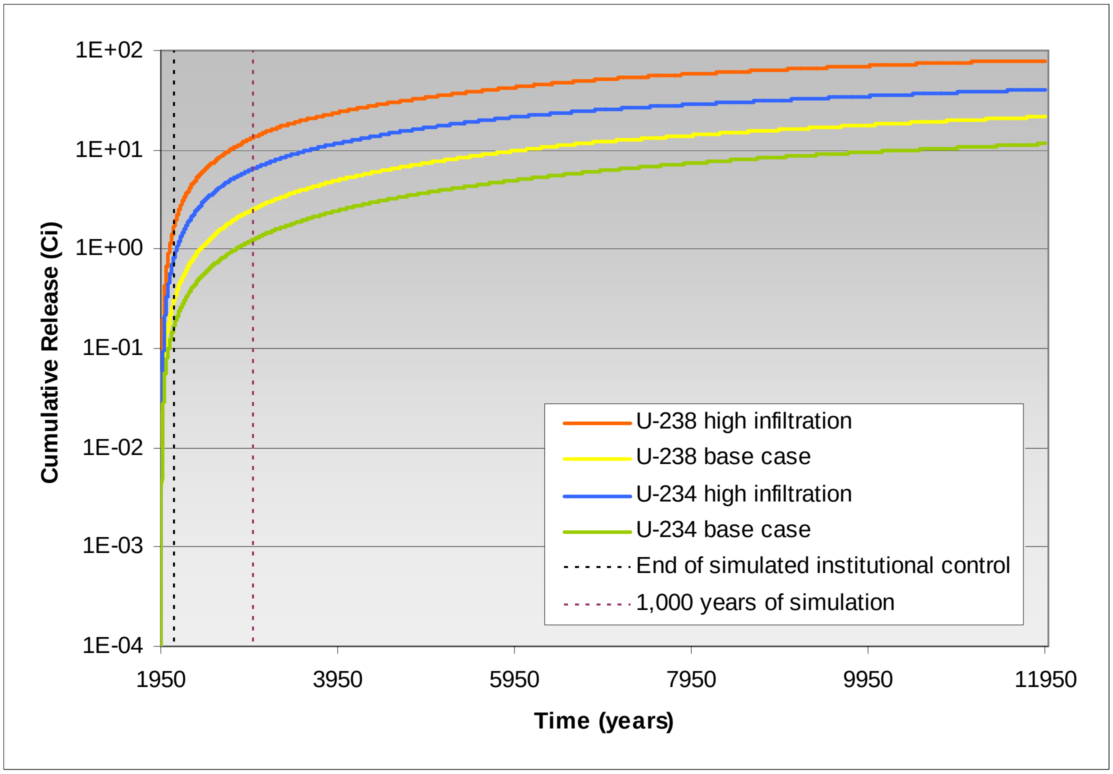


Figure 5-26. Comparison of uranium-238 and -234 cumulative releases for the high-infiltration sensitivity case.

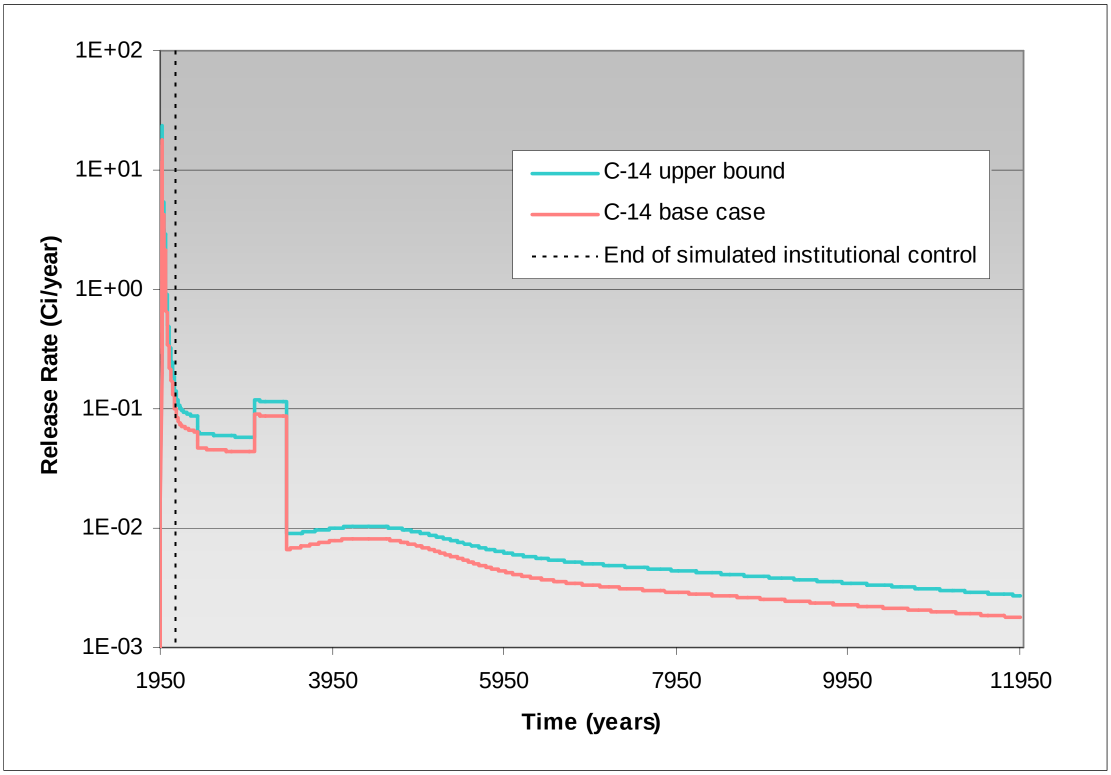


Figure 5-27. Comparison of carbon-14 release for the no-retrieval and no-grout sensitivity case.

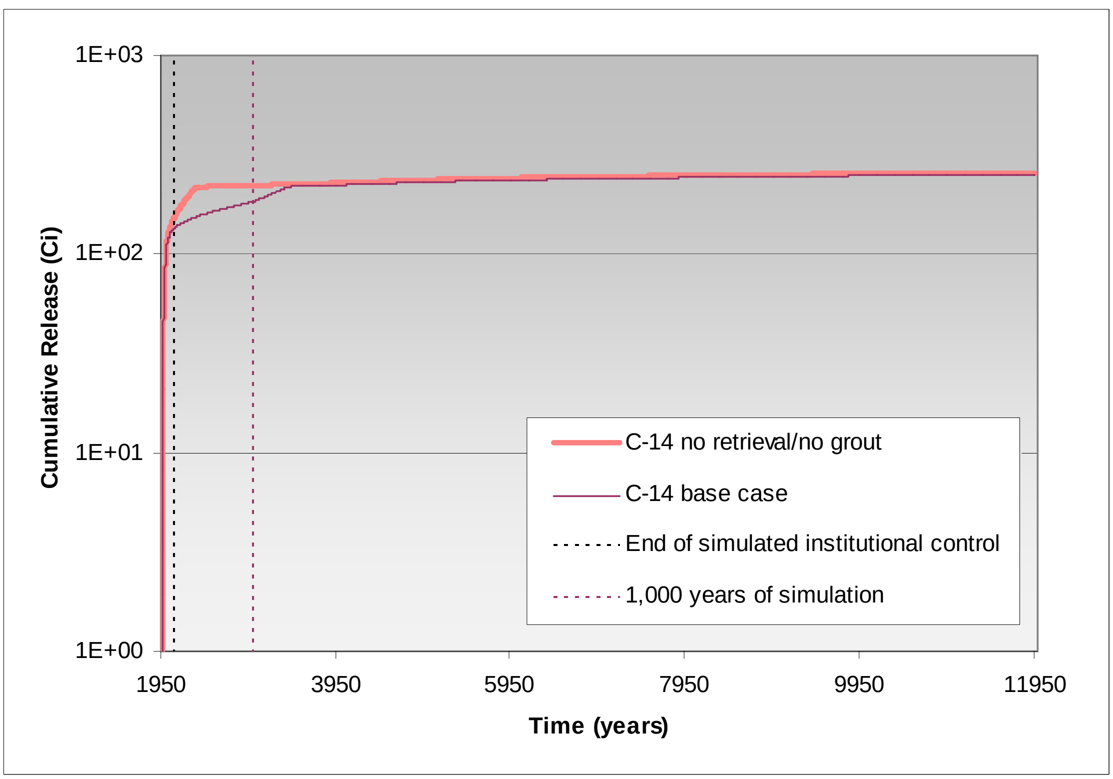


Figure 5-28. Comparison of carbon-14 cumulative release for the no-retrieval and no-grout sensitivity case.

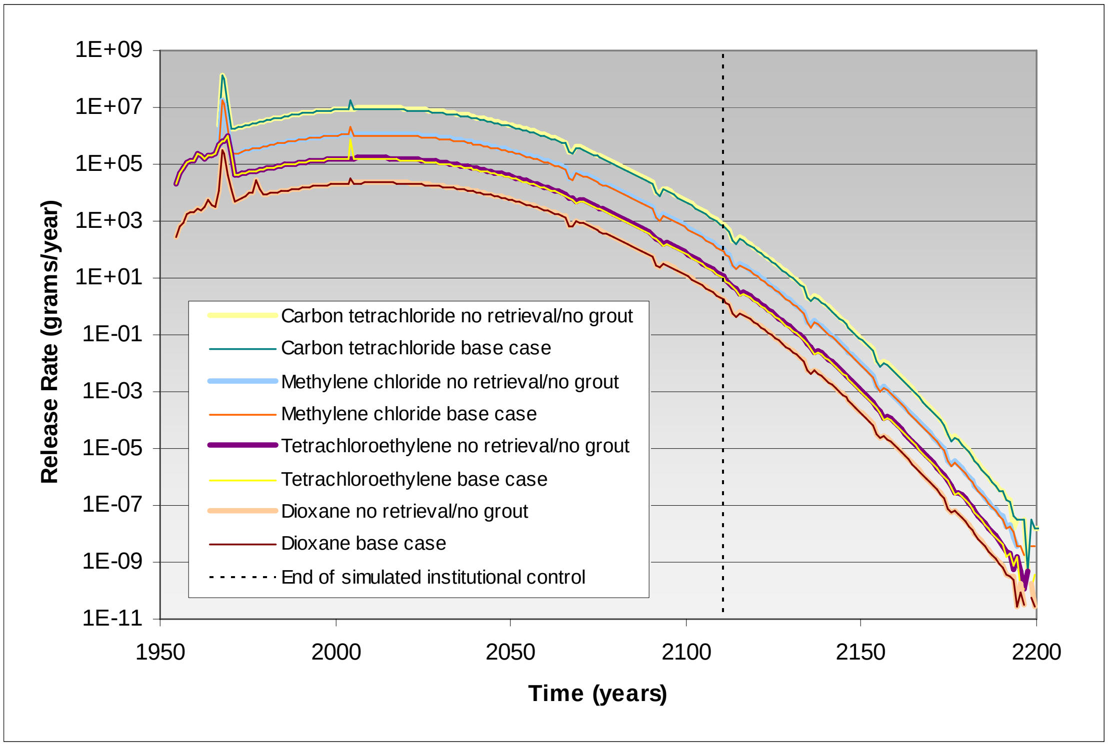


Figure 5-29. Comparison of volatile organic compound release for the no-retrieval and no-grout sensitivity case.

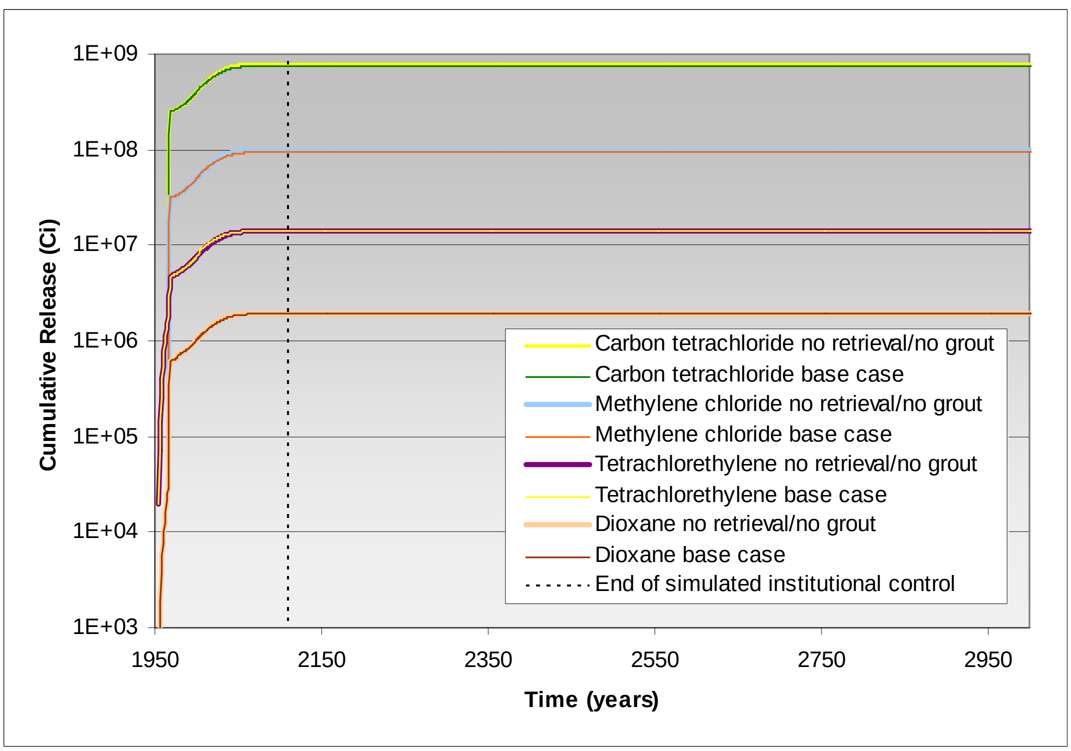


Figure 5-30. Comparison of volatile organic compound cumulative release for the no-retrieval and no-grout sensitivity case.

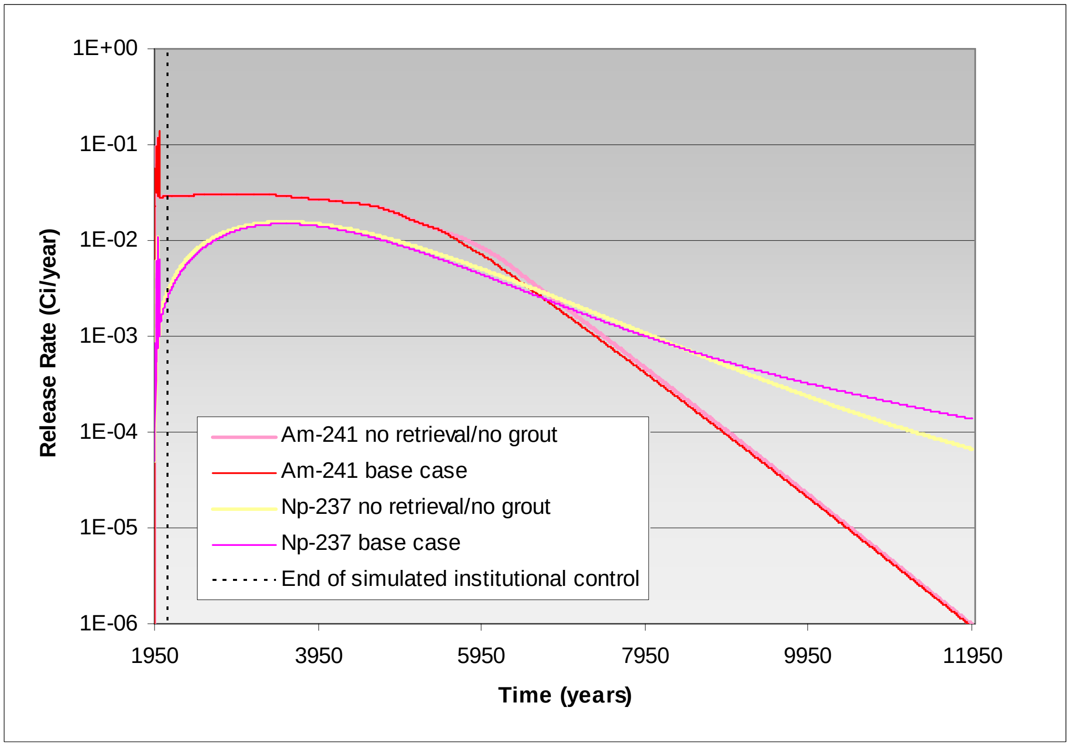


Figure 5-31. Comparison of americium-241 and neptunium-237 release for the no-retrieval and no-grout sensitivity case.

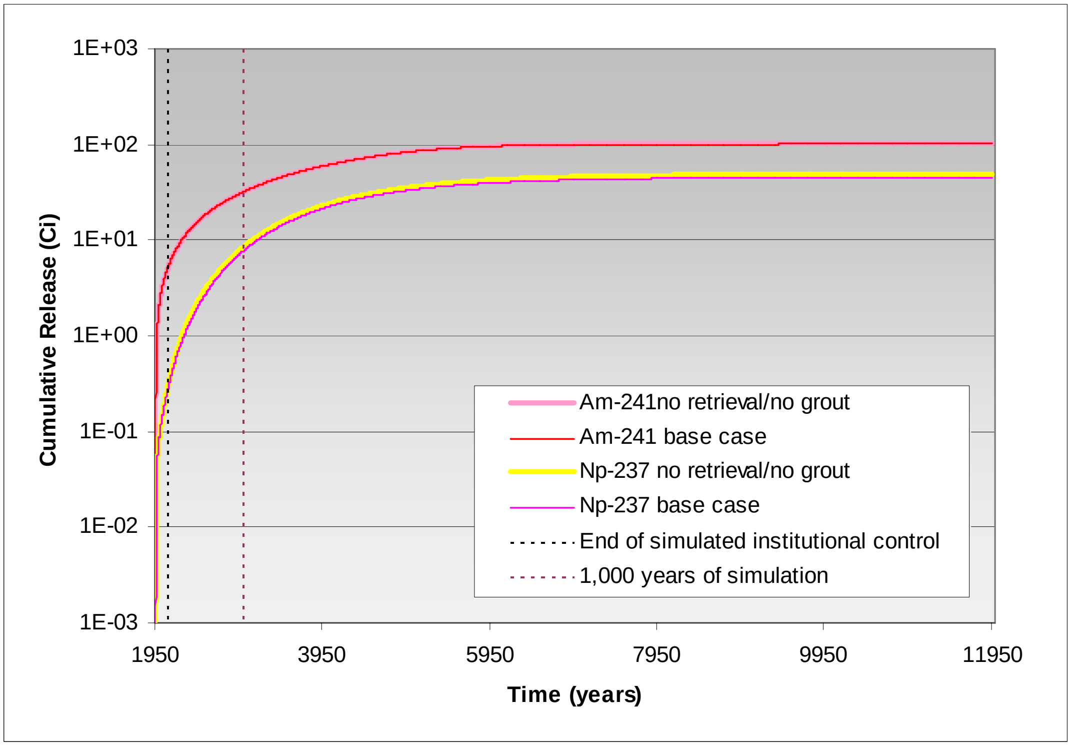


Figure 5-32. Comparison of americium-241 and neptunium-237 cumulative release for the no-retrieval and no-grout sensitivity case.

6. FEASIBILITY STUDY CASES

This section presents results of the feasibility study simulations. The feasibility study evaluates the long-term effectiveness of assembled alternatives.

One issue that arose during remedial investigation simulations was a prediction that most of the mass of Tc-99 and I-129 had already released and that no remediation would have any effect. However, because the Tc-99 and I-129 simulations grossly overpredicted the concentrations, compared with measured concentrations in both the vadose zone and aquifer, further evaluation of the release of both these contaminants was warranted. Upon review, it was determined that some of the simplifying assumptions used in the modeling were too conservative. Working with representatives of the Idaho Department of Environmental Quality, a more realistic set of assumptions was developed and a new base case for Tc-99 and I-129 developed.

In the process of reworking the Tc-99 and I-129 source release, an error in the DUST-MS code was uncovered. The code author was contacted and a contract was put in place to correct the problem. Numerous test cases were run to ensure there were no other issues with the code. Section 6.1 discusses the code modifications and validation. Section 6.2 discusses the methodology and results for the new Tc-99 and I-129 base case.

6.1 DUST-MS Corrections

In developing the new Tc-99 and I-129 base case, the uniform failure distribution was used (see Section 6.2 for details). In reviewing the release using this container-failure model, it was noticed that the results were not uniform. The code author was contacted and a contract put in place to correct the error. A new version of DUST-MS resulted (v5). The preretrieval cases were rerun to assess impacts of the change in the code on the final risk assignment. This section details the results of this effort.

The remedial investigation B4ng case (base case with no Accelerated Retrieval Project retrieval and no grouting) was run with the corrected version of the code and the source-release results compared to the results in the draft Remedial Investigation And Baseline Risk Assessment (RI/BRA),[b] calculated with Version 4. The change only affects the surface-wash release mechanism, and the impact is largest for the highly mobile (zero K_d) contaminants. Vadose zone and groundwater simulations were rerun for Groups 2, 3, and 10 contaminants. Groups 2 and 3 have a fraction of the total plutonium inventory released as colloidal plutonium, which is modeled as having a zero K_d. Group 10 is nitrate, which also has a zero K_d.

Figures 6-1 and 6-2 show the difference in the source-release plots for Pu-239. The major differences occur in the early period (<100 years) due to the mobile colloidal fraction. The overall impact to the groundwater ingestion risk is expected to be low because the colloidal fraction is assumed to be mechanically filtered in the B-C and C-D interbeds. The Pu-240 figures are similar to the Pu-239 figures.

Figure 6-3 shows the nitrate release as a function of time. As the figure shows, the peak releases are the same, but the Version 5 results are spread over a longer period. Because of the 100 years of institutional control assumed for the Subsurface Disposal Area (SDA), the groundwater ingestion risk from nitrate might increase slightly as a result. However, nitrate has been identified as a groundwater contaminant of concern; therefore, there is no impact to the feasibility study. As seen in both the Pu-239 and nitrate plots, Version 5 corrects some of the problems, which were manifested as spikes in the release. These spikes are associated with the identified error in DUST-MS. Also, checks were made with Mathcad to determine if the additional spread on the Gaussian release makes sense. The new results match what is computed for the Gaussian failure distribution with Version 5.

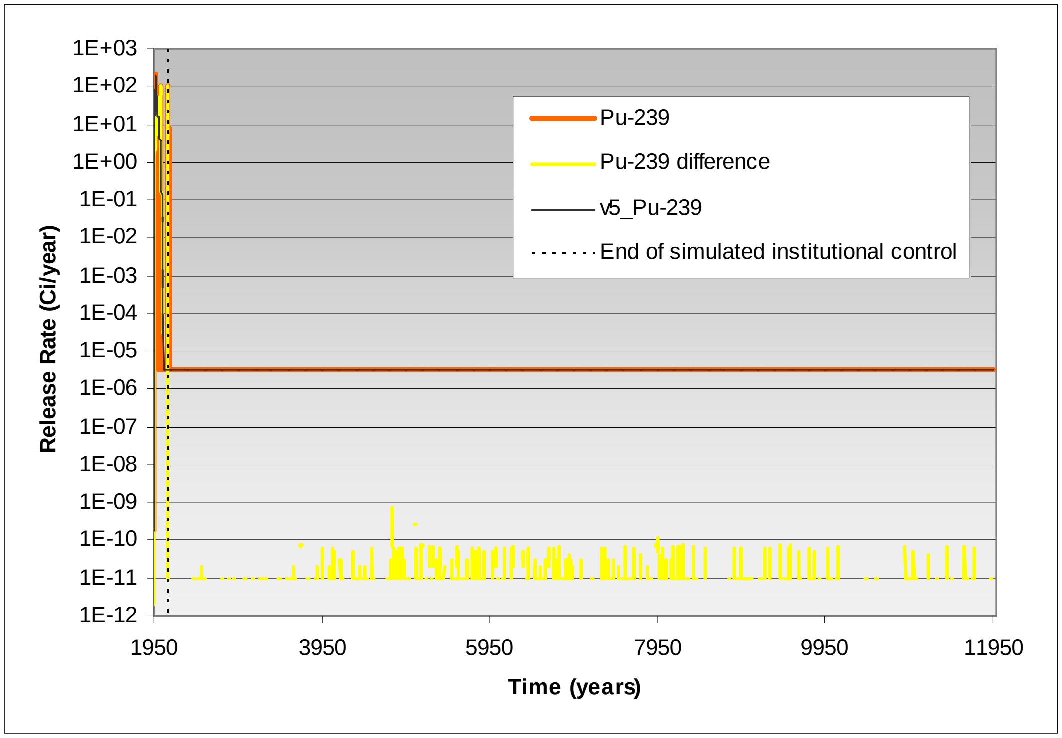


Figure 6-1. Comparison of the release of plutonium-239 including colloidal fraction for 10,000 years of simulation time.

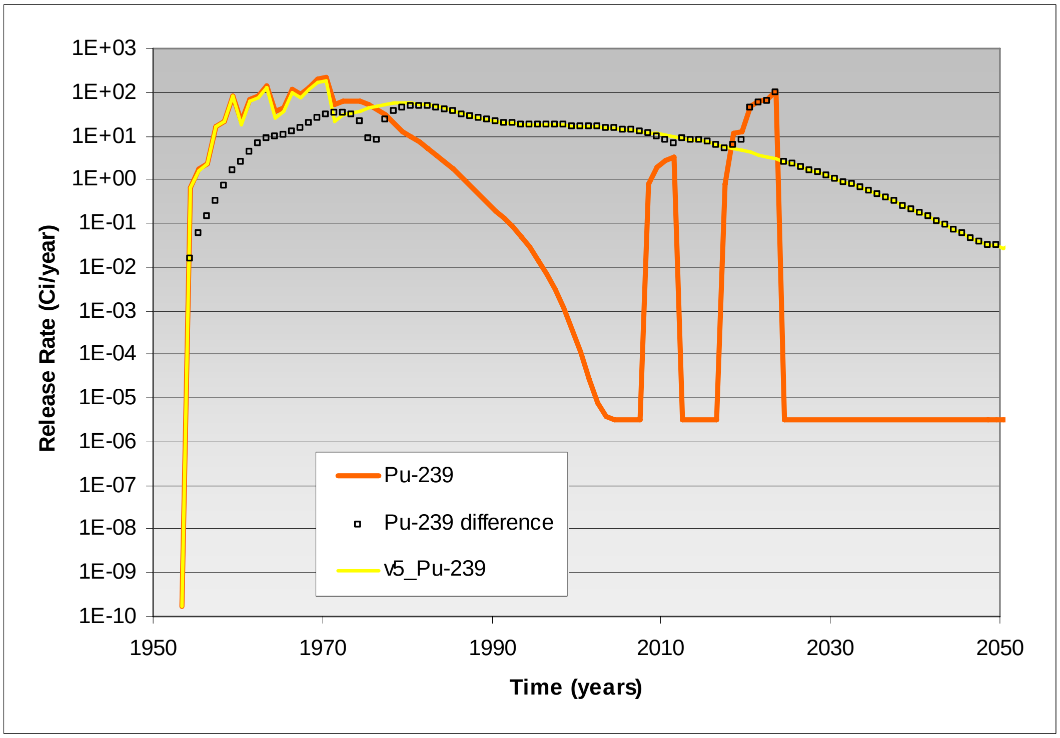


Figure 6-2. Comparison of the release of plutonium-239 including colloidal fraction for 100 years of simulation time.

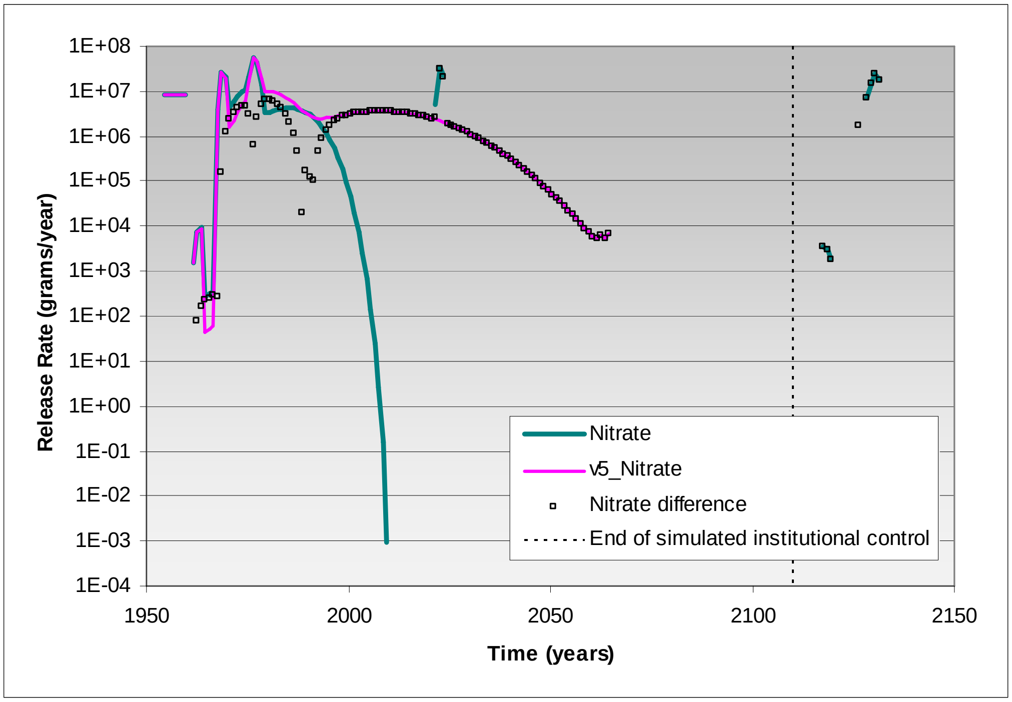


Figure 6-3. Comparison of the release of nitrate for 200 years of simulation time.

Figure 6-4 shows the source-release results for Am-241. These results for Am-241 are typical for less mobile contaminants (K_d>0.). The difference between Version 4 and Version 5 results is very small and is most likely a function of the precision with which the output files are written when computing the difference.

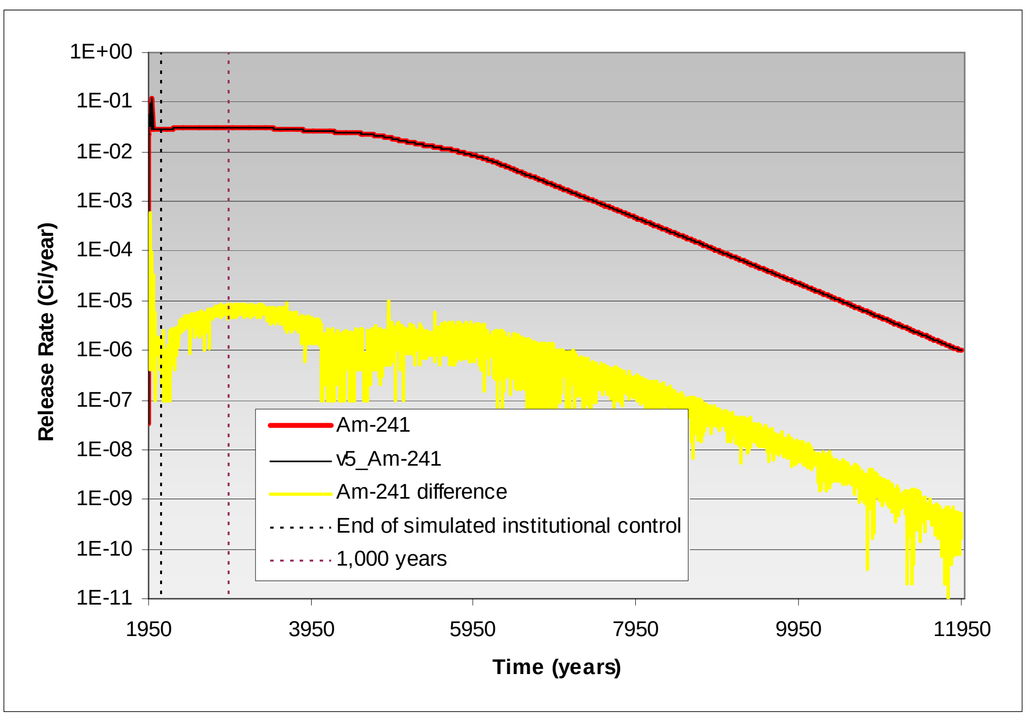


Figure 6-4. Comparison of the release of americium-241 for 10,000 years of simulation time.

Contaminants such as carbon tetrachloride show no change because the release is controlled by the diffusion model. Only the surface-wash model was affected by this error.

6.2 New Technetium-99 and Iodine-129 Base Case

For the remedial investigation, Tc-99, I-129, and Cl-36 were modeled together as Group 6. Inventories for each of the three isotopes were allocated among six waste streams, and each waste stream was identified by a single-letter designator. These waste streams and designators were:

- Activated metal (A) = activation products within metal components
- Beryllium (B) = activation products in beryllium blocks
- Fuel (F) = fission products in fuel-like materials (e.g., test specimens)
- Resins (R) = fission or activation products in resins
- Vycor (V) = fission products in Vycor glass components
- Surface wash (W) = surface contamination subject to wash off.

One of three Gaussian container-failure distributions was assigned to each waste stream in terms of three parameters. The parameters were:

- Initial failure fraction
- Mean-time to failure
- Standard deviation (σ).

One distribution was used for uncontained waste, one for randomly dumped drums, and one for stacked drums. Distribution parameters for the three distributions are shown in Table 6-1. For the remedial investigation, most waste was assumed to be uncontained. All contained waste was assumed to be in drums similar to those containing Rocky Flats Plant waste. The fraction of drums that was stacked or dumped depended on the burial year and location.

Table 6-1. Container-failure distribution parameters for the remedial investigation.

	Mean Time to Failure (years)	σ (years)	Initial Failure Fraction
No containers	0.000E+00	0.000E+00	0.000
Dumped	1.170E+01	5.000E+00	0.285
Stacked	3.410E+01	1.460E+01	0.000

This methodology predicted extremely rapid release, which was not supported by sample monitoring results.

For the feasibility study, Cl-36 was not remodeled. Chlorine-36 screens with the original modeling. Including the less conservative container failure rates identified below would reduce the risk from Cl-36 further. Because it had already screened out, additional work revising the simulation results was not warranted. Technetium-99 and I-129 were modeled together as Group 12. A new group number was assigned to avoid confusing the feasibility study data input and outputs files with the remedial investigation files. Technetium-99 and I-129 modeling was revised for the feasibility study to include refined detail in container-failure release mechanisms in an attempt to align the prediction with sample monitoring results. Much of the fuel-related waste, resin, and surface-wash waste assumed to be uncontained was in fact contained, often in long-lasting containers. For the feasibility study, inventory for Tc-99 and I-129 was allocated to five general container-failure categories, within each of the six waste streams, based on assumed similarities in failure parameters. The distinction between stacked drums and randomly dumped drums, associated with Rocky Flats Plant waste, was not modeled because neither Tc-99 nor I-129 is associated with Rocky Flats Plant waste. A failure distribution was assigned to each category as follows:

- Immediate failure = no container or insubstantial container, container failure and start of release is immediate
- Early failure = thin-walled carbon steel container (e.g., 30- and 55-gal drums), container failure and start of release in 0 to 500 years, assuming a normal distribution: Mean time to failure = 250 years, σ = 100 years
- Late failure = stainless steel container or thick-walled carbon steel container, container failure and start of release in 500 to 1,000 years, assuming a normal distribution: Mean time to failure = 750 years, σ = 100 years
- Wide failure = primary or secondary container is polyethylene (see note below), container failure and start of release in 0 to 1,000 years, assuming a uniform distribution
- No failure = encased in thick-walled concrete, no container failure and no release within 1,000 years, not included in modeled inventory.

NOTE: *Assuming they are not breached during burial, failure of polyethylene containers highly depends on the strength of the radiation field. Analysis indicates that more than 95% of the polyethylene containers have an expected life span of greater than 1,000 years. Polyethylene containers with a life span of less than or equal to 1,000 years, based on the radiation field, are assigned to the "wide failure" category. Polyethylene containers with a life span greater than 1,000 years are assigned to the "no failure" category and are not included in the model inventory. For waste in polyethylene bags, it was assumed that a single bag was used. Generally, however, waste was double bagged. This results in a conservative estimate.*

These failure distributions are summarized in Tables 6-2 and 6-3. Details on how the waste inventory was evaluated and categorized are provided in Appendix D. The number of failure categories was set at five to limit the complexity. Tables 6-4 and 6-5 summarize the Tc-99 and I-129 inventory by waste stream and container-failure category.

Table 6-2. Container-failure distribution parameters for the feasibility study.

Failure Category		NDISTR[a]	TIMEF[a] (years)	TIMEF2[a] (years)	FAILINT[a] (years)	DUST Failure Distribution Model	Container-failure Assumption
Immediate	I	0	0	0	0	Instantaneous	Immediately failure
Early	E	2	250	100	0	Normal	Failure in 0 to 500 years; normal distribution
Late	L	2	750	100	0	Normal	Failure in 500 to 1,000 years; normal distribution
Wide	W	1	0	1,000	0	Uniform	Failure in 0 to 1,000 years; uniform distribution
None	N	1	1,000	10,000	0	Uniform	No failure/no release

a. See Table 6-3 for parameter definitions.

Table 6-3. Parameter definitions for Table 6-2.

DUST Failure Distribution Model	NDISTR	TIMEF	TIMEF2	FAILINT
Instantaneous	0	Failure time	(ignored)	(ignored)
Uniform	1	Failure start	Failure stop	Initial failure fraction
Normal	2	Mean time to failure	Std Dev	Initial failure fraction

Table 6-4. Technetium-99 inventory for feasibility study (compared with the remedial investigation).

Release Mechanism	Container Category	FS Curies	RI Curies	Release Mechanism	Container Category	FS Curies	RI Curies
Activated metal	Immediate	8.26E-01		Resins	Immediate	4.46E-01	
Activated metal	Early	4.09E-02		Resins	Early	8.42E-02	
Activated metal	Late	1.31E+01		Resins	Late	2.72E+00	
Activated metal	Wide	1.84E-01		Resins	Wide	6.22E-01	
Activated metal	None	1.04E-01		Resins	None	3.42E-01	
	Total =	**1.42E+01**	**1.50E+01**		**Total =**	**4.22E+00**	**4.21E+00**

Release Mechanism	Container Category	FS Curies	RI Curies	Release Mechanism	Container Category	FS Curies	RI Curies
Beryllium blocks	Immediate	1.06E-02		Vycor glass	Immediate	0.00E+00	
Beryllium blocks	Early	6.72E-05		Vycor glass	Early	6.61E+00	
Beryllium blocks	Late	1.35E-03		Vycor glass	Late	0.00E+00	
Beryllium blocks	Wide	0.00E+00		Vycor glass	Wide	4.85E-02	
Beryllium blocks	None	0.00E+00		Vycor glass	None	7.30E-03	
	Total =	**1.20E-02**	**1.20E-02**		**Total =**	**6.67E+00**	**6.67E+00**

Table 6-4. (continued).

Release Mechanism	Container Category	FS Curies	RI Curies	Release Mechanism	Container Category	FS Curies	RI Curies
Fuel-like material	Immediate	5.42E-01		Surface wash	Immediate	1.62E+00	
Fuel-like material	Early	1.11E-01		Surface wash	Early	6.51E-01	
Fuel-like material	Late	3.14E+00		Surface wash	Late	4.70E-01	
Fuel-like material	Wide	5.58E-02		Surface wash	Wide	9.25E-01	
Fuel-like material	None	4.79E-01		Surface wash	None	5.85E+00	
	Total =	**4.33E+00**	**4.24E+00**		**Total =**	**9.52E+00**	**1.07E+01**
		FS Curies	RI Curies				
	Grand Total =	**3.89E+01**	**4.08E+01**				

Note 1: Does not include projected low-level waste.
Note 2: Delta between RI and FS is due to corrections in inventory.

Table 6-5. Iodine-129 inventory for feasibility study (compared with remedial investigation).

Release Mechanism	Container Category	FS Curies	RI Curies	Release Mechanism	Container Category	FS Curies	RI Curies
Activated metal	Immediate	2.66E-03		Resins	Immediate	1.11E-02	
Activated metal	Early	5.01E-05		Resins	Early	1.98E-03	
Activated metal	Late	1.68E-05		Resins	Late	6.72E-02	
Activated metal	Wide	1.55E-07		Resins	Wide	2.65E-03	
Activated metal	None	9.16E-05		Resins	None	2.50E-03	
	Total =	**2.82E-03**	**7.44E-04**		**Total =**	**8.54E-02**	**8.65E-02**
Beryllium blocks	Immediate	8.82E-05		Vycor glass	Immediate	0.00E+00	
Beryllium blocks	Early	5.21E-07		Vycor glass	Early	1.79E-02	
Beryllium blocks	Late	1.09E-05		Vycor glass	Late	0.00E+00	
Beryllium blocks	Wide	0.00E+00		Vycor glass	Wide	1.31E-04	
Beryllium blocks	None	0.00E+00		Vycor glass	None	2.00E-05	
	Total =	**9.97E-05**	**9.91E-05**		**Total =**	**1.80E-02**	**1.80E-02**
Fuel-like material	Immediate	1.10E-03		Surface wash	Immediate	2.63E-03	
Fuel-like material	Early	2.24E-04		Surface wash	Early	1.22E-03	
Fuel-like material	Late	6.90E-03		Surface wash	Late	7.85E-04	
Fuel-like material	Wide	1.12E-04		Surface wash	Wide	2.38E-03	
Fuel-like material	None	9.77E-04		Surface wash	None	1.38E-02	
	Total =	**9.31E-03**	**9.18E-03**		**Total =**	**2.08E-02**	**2.10E-02**
		FS Curies	RI Curies				
	Grand Total =	**1.36E-01**	**1.36E-01**				

Note: Does not include projected low-level waste.

The first of the simulations for the new feasibility study base case have been run through Version 5 of the source model. The cumulative release of Tc-99 for the year 2005 is reduced from 16.9 Ci to 2.26 Ci. Figure 6-5 shows the Tc-99 release as a function of time for the 10,000-year time frame. Figures 6-6 and 6-7 show the cumulative release of Tc-99 for 10,000 and 1,000 years, respectively. Over the 10,000-year simulation period, the remedial investigation model released 25 Ci, while the feasibility study model released 22.1 Ci. The feasibility study model spreads the release over time more than the remedial investigation model, which has a large spike in the release in the early years.

The impact to the predicted vadose zone concentrations for the current time frame is expected to be roughly an order of magnitude. While this will not make the predictions match the measured values, it will bring the predictions closer to the measured values and still provide a conservative estimate of the impact to the aquifer.

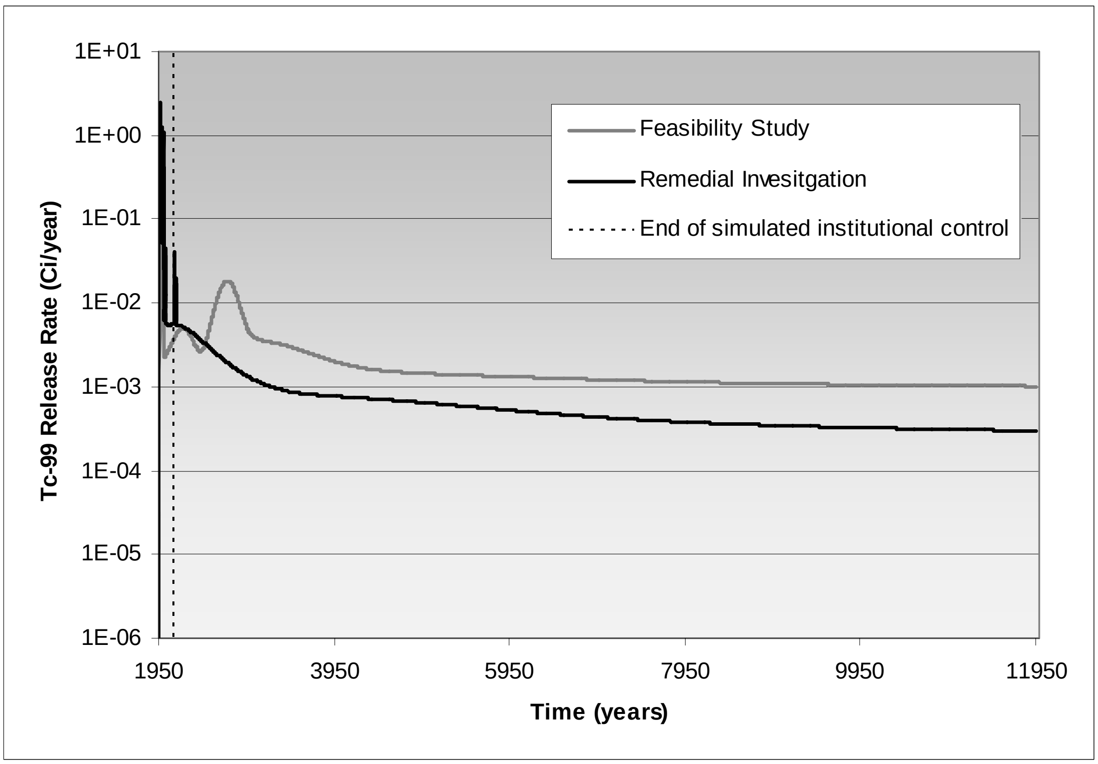


Figure 6-5. Comparison of the remedial investigation and feasibility study base case with no Accelerated Retrieval Project retrieval and no grouting case technetium-99 source release.

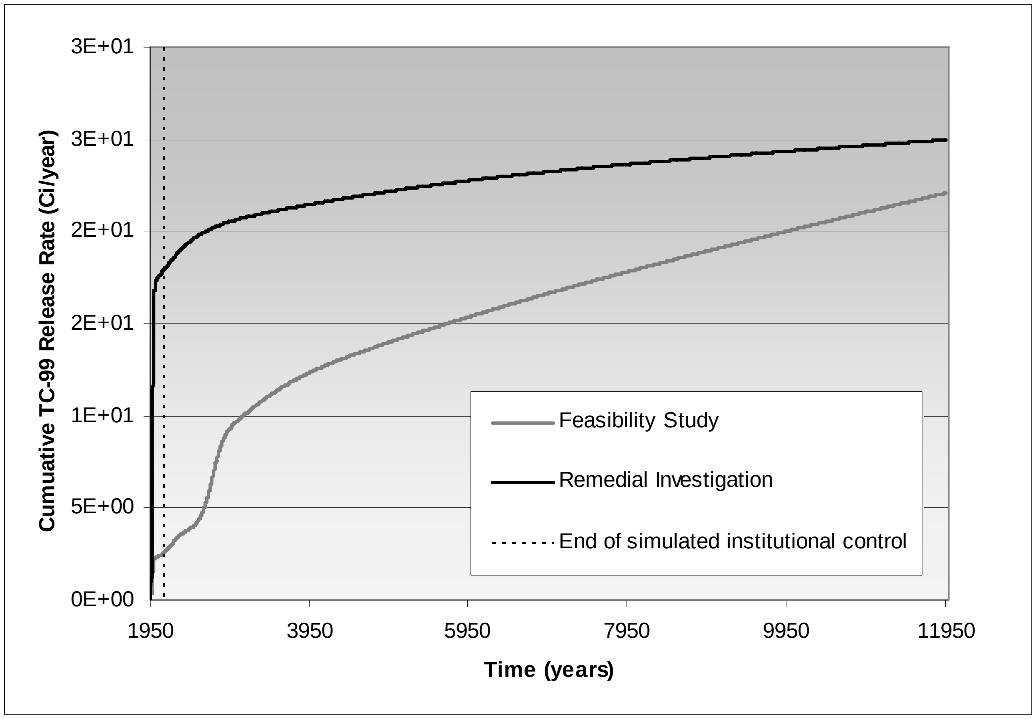


Figure 6-6. Comparison of the cumulative release of technetium-99 between the remedial investigation and feasibility study models for 10,000 years of simulation time.

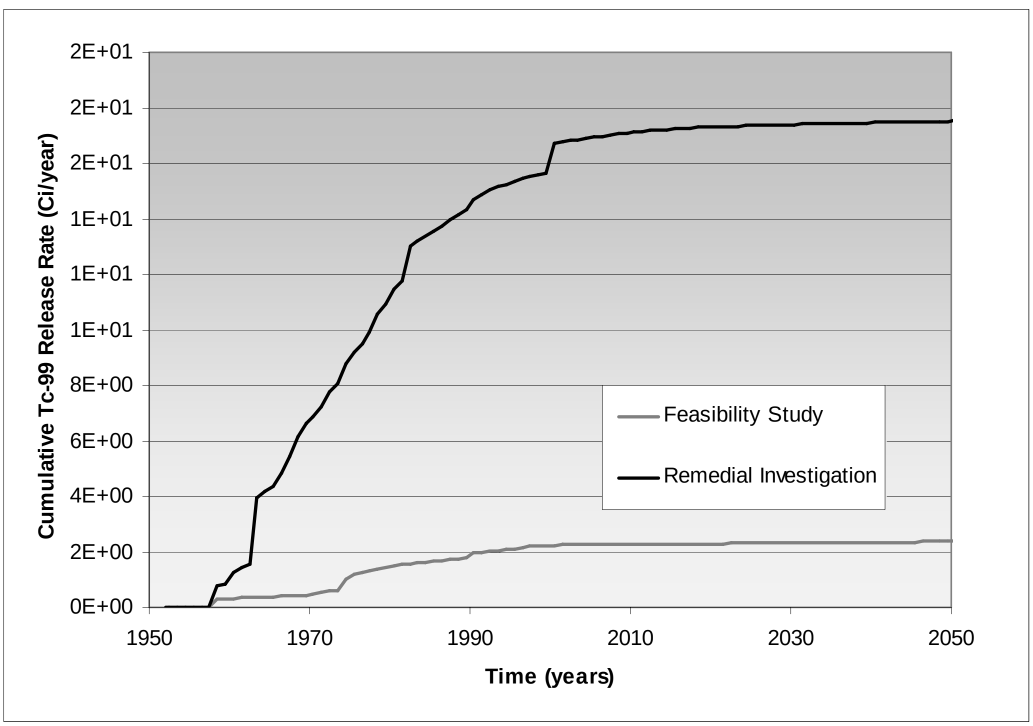


Figure 6-7. Comparison of the cumulative release of technetium-99 between the remedial investigation and feasibility study models for 100 years of simulation time.

7. QUALITY ASSURANCE

Previous assessments (e.g., the Ancillary Basis for Risk Analysis [ABRA] [Holdren et al. 2002] and the Interim Risk Assessment [IRA] [Becker et al. 1998]) included quality assurance checks to ensure that the correct mass was input to the models and the appropriate mass was released from the models. Additional checks were performed to ensure that in the handoff between models, the mass was conserved. For the remedial investigation and feasibility study (RI/FS), a more formal and detailed process was adopted and is document in Figure 7-1. Quality assurance logs detailing the checks performed and the date completed are in the Operable Unit (OU) 7-13/14 Project files.

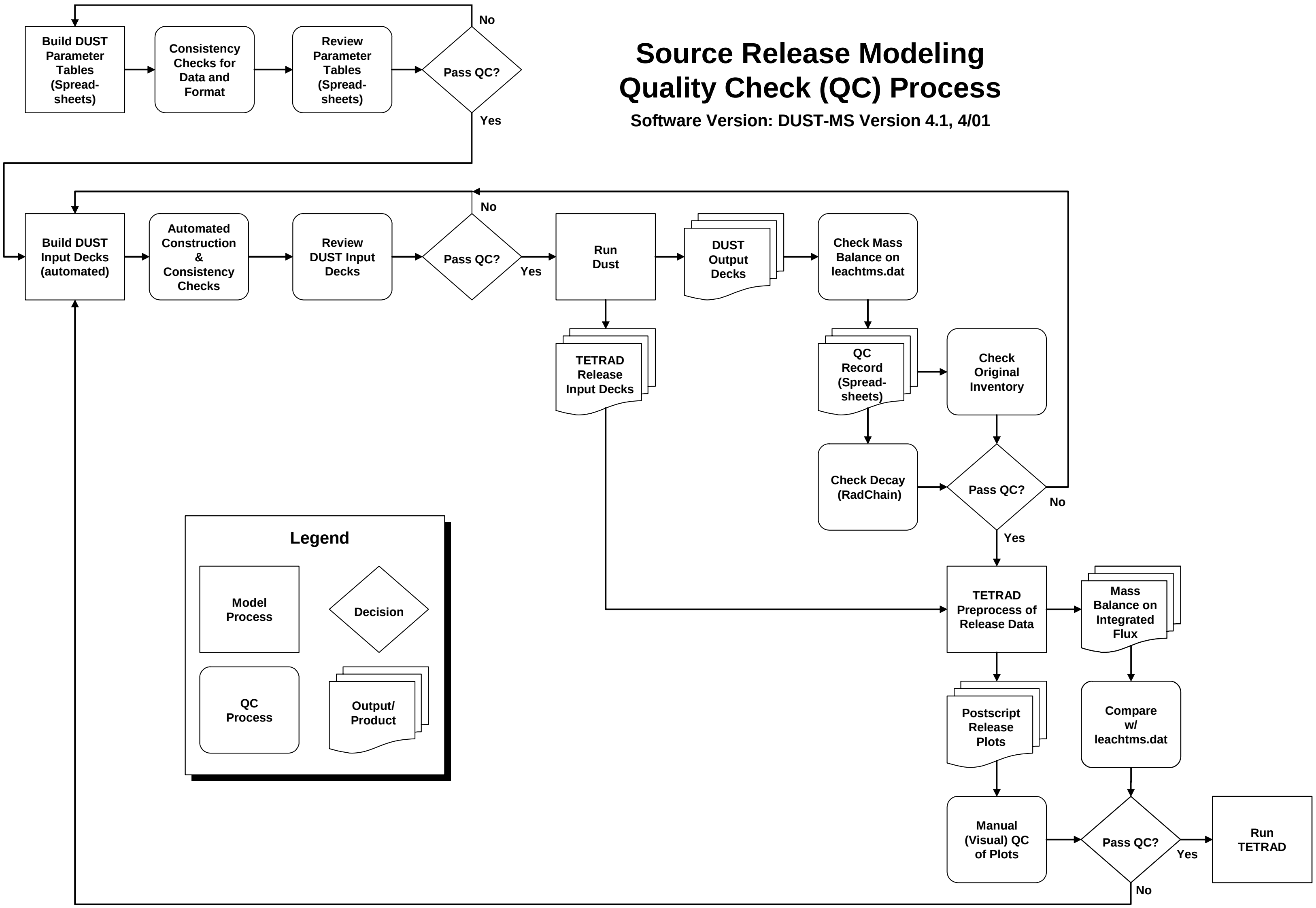


Figure 7-1. Quality check process flowchart.

8. CONCLUSIONS

The release of contaminants from the source term was simulated using DUST-MS computer modeling code. The source-release simulation, as it has evolved through the many iterations of risk assessment, conservatively represents the release of contaminants in the shallow subsurface. The model outputs were used as inputs for further fate and transport simulations and ultimately the risk assessment to support the Operable Unit 7-13/14 remedial investigation and feasibility study (Magnuson and Sondrup 2006). Comparisons to measured data show the model overpredicts the concentrations and are, therefore, conservative in estimating the groundwater risk. Risk results are reported in draft Holdren et al. (2005).[b]

Comparison of concentrations for two contaminants, Tc-99 and I-129, showed that predicted results grossly overpredicted measured concentrations. Further evaluation of these contaminants identified conservative assumptions on the container-failure model used. Therefore, these two contaminants were remodeled to more adequately assess remedial effectiveness. Predicted concentrations are still conservative, but not so overly conservative that no remediation would affect overall risk.

In the process of rework, an error in the source-release code was identified. The code author was contracted to fix the error. The impact on previous results was determined to be less than uncertainty in some of the input parameters; therefore, the entire set of simulations was not repeated. The largest impact was for highly mobile contaminants such as Tc-99, I-129, and nitrate. Nonetheless, Tc-99 and I-129 were remodeled because of inappropriate assumptions used in the original modeling, and nitrate was already identified as a contaminant of concern.

9. REFERENCES

Adler Flitton, M. K., C. W. Bishop, R. E. Mizia, L. L. Torres, and R. D. Rogers, 2001, *Long Term Corrosion/Degradation Test Third-Year Results*, INEEL/EXT-01-00036, Rev. 0, Idaho National Engineering and Environmental Laboratory.

Anderson, Danny L. and Bruce H. Becker, 2006, *Source-Release Modeling Report for OU 7-13/14*, ICP/EXT-05-01039, Idaho National Laboratory, Idaho Cleanup Project.

Baca, R. G., S. O. Magnuson, H. D. Nguyen, and P. Martian, 1992, *A Modeling Study of Water Flow in the Vadose Zone Beneath the Radioactive Waste Management Complex*, EGG-GEO-10068, EG&G Idaho, Inc., Idaho Falls, ID.

Batcheller, Thomas A. and George D. Redden, 2004, *Colloidal Plutonium at the OU 7-13/14 Subsurface Disposal Area: Estimate of Inventory and Transport Properties*, ICP/EXT-04-00253, Rev. 0, Idaho National Laboratory, Idaho Cleanup Project.

Bechtold, Thomas E., ICP, to K. Jean Holdren, ICP, January 04, 2005, "EDIT – Fractional Release Rate for Leached Vycor Glass," EDMS No. 1714586.

Becker, B. H., 1997, *Selection and Development of Models Used in the Waste Area Group 7 Baseline Risk Assessment*, INEEL/EXT-97-00391, Rev. 0, Idaho National Engineering and Environmental Laboratory.

Becker, B. H., T. A. Bensen, C. S. Blackmore, D. E. Burns, B. N. Burton, N. L. Hampton, R. M. Huntley, R. W. Jones, D. K. Jorgensen, S. O. Magnuson, C. Shapiro, and R. L. VanHorn, 1996, *Work Plan for Operable Unit 7-13/14 Waste Area Group 7 Comprehensive Remedial Investigation/Feasibility Study*, INEL-95/0343, Rev. 0, Idaho National Engineering Laboratory.

Becker, B. H., J. D. Burgess, K. J. Holdren, D. K. Jorgensen, S. O. Magnuson, and A. J. Sondrup, 1998, *Interim Risk Assessment and Contaminant Screening for the Waste Area Group 7 Remedial Investigation*, DOE/ID-10569, Rev. 0, U.S. Department of Energy Idaho Operations Office.

Burns, D. E., B. H. Becker, and R. W. Jones, 1994, *Preliminary Scoping Track 2 Summary Report for Operable Unit 7-01*, INEL-94/0241, Idaho National Engineering Laboratory.

Burns, D. E., B. H. Becker, R. M. Huntley, C. A. Loehr, S. M. Rood, P. Sinton, and T. H. Smith, 1994, *Revised Preliminary Scoping Risk Assessment for Waste Pits, Trenches, and Soil Vaults at the Subsurface Disposal Area, Idaho National Engineering Laboratory*, EGG-ER-11395, Rev. 0, Idaho National Engineering Laboratory.

DOE, 2002, *Agreement to Resolve Disputes, the State of Idaho, United States Environmental Protection Agency, United States Department of Energy*, Administrative Record No. 10970, U.S. Department of Energy, State of Idaho, U.S. Environmental Protection Agency.

DOE G 435.1-1, 1999, "Crosswalk Tables DOE Order 5820.2A vs. DOE Order 435.1/M 435.1-1," U.S. Department of Energy.

DOE-ID, 1991, *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory*, Administrative Docket No. 1088-06-29-120, U.S. Department of Energy Idaho Operations Office; U.S. Environmental Protection Agency, Region 10; Idaho Department of Health and Welfare.

DOE-ID, 2004, *Remedial Action Report for the OU 7-10 Glovebox Excavator Method Project*, DOE/NE-ID-11155, Rev. 0, U.S. Department of Energy Idaho Operations Office.

EPA, 2001, *Health Effects Assessment Summary Tables, Annual Update*, PB95 921199, U.S. Environmental Protection Agency.

Grossman, C. J., R. A. Fjeld, J. T. Coates, and A. W. Elzerman, 2001, *Task 7 Final Report: The Sorption of Selected Radionuclides in Sedimentary Interbed Soils from the Snake River Plain*, Administrative Record No. 24484, prepared by the Department of Environmental Engineering and Sciences, Clemson University, Clemson, South Carolina, for the Idaho National Engineering and Environmental Laboratory.

Hanson, Duane, G. E. Matthern, N. A. Yancey, and D. L. Knudson, 2004, *Evaluation of the Durability of WAXFIX for Subsurface Applications*, ICP/EXT-04-00300, Rev. 0, Idaho National Engineering and Environmental Laboratory, Idaho Completion Project.

Holdren, K. Jean, Bruce H. Becker, Nancy L. Hampton, L. Don Koeppen, Swen O. Magnuson, T. J. Meyer, Gail L. Olson, and A. Jeffrey Sondrup, 2002, *Ancillary Basis for Risk Analysis of the Subsurface Disposal Area*, INEEL/EXT-02-01125, Rev. 0, Idaho National Engineering and Environmental Laboratory.

Holdren, K. Jean and Barbara J. Broomfield, 2004, *Second Addendum to the Work Plan for the OU 7-13/14 Waste Area Group 7 Comprehensive Remedial Investigation/Feasibility Study*, DOE/ID-11039, U.S. Department of Energy Idaho Operations Office.

Hull, Larry, INL, to Roger Seitz, ICP, August, 13, 2004, "Effective Kd to Use for Tc Release from Resin Bed Columns in the SDA," EDMS No. 1706988.

Hull, Larry, INL, to Erick Neher, ICP, September 25, 2003, "Response to Tally Jenkins Comments on the Berkey/Wierenga/Roback Review of Plutonium Kd," EDMS No. 1587199.

Hull, Laurence and Mary N. Pace, 2000, *Solubility Calculations for Contaminants of Potential Concern, OU 7-13/14*, INEEL/EXT-2000-00465, Idaho National Engineering and Environmental Laboratory.

INEL, 1994, *A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried in the Subsurface Disposal Area of the INEL RWMC during the Years 1952-1983*, EGG-WM-10903, Rev. 0, Idaho National Engineering Laboratory.

INEL, 1995a, *A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1952-1983*, INEL-95/0310 (formerly EGG-WM-10903), Rev. 1, Idaho National Engineering Laboratory.

INEL, 1995b, *A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried or Projected to Be Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1984-2003*, INEL-95/0135, Rev. 1, Idaho National Engineering Laboratory.

Kozak, Dr. Matt, Dr. Man-Sung Yim, and Dr. Terry Sullivan, 2003, *Independent Peer Review of Source Term Modeling for the INEEL Subsurface Disposal Area*, ICP/EXT-03-00081, Rev. 0, prepared by Brookhaven National Laboratory for the Idaho National Engineering and Environmental Laboratory.

Leecaster, Molly K. and Laurence C. Hull, 2004, *Spatial Distribution of Neptunium and Uranium Partition Coefficient (Kd) for Interbed Sediments at a Radioactive Waste Subsurface Disposal Area*, ICP/EXT-03-00088, Rev. 0, Idaho National Engineering and Environmental Laboratory, Idaho Completion Project.

Little, Marianne, Joan K. McDonald, Jon D. Grandy, Michael L. Carboneau, Andrea G. Chambers, Shannon C. Flynn, L. Don Koeppen, and John A. Logan, 2001, *A Comprehensive Inventory of Radiological and Nonradiological Contaminants Buried or Projected to Be Buried in the Subsurface Disposal Area of the INEEL RWMC During the Years 1984 to 2003 Supplement*, INEL-95/0135, Supplement, Rev. 0, Idaho National Engineering and Environmental Laboratory.

Loehr, C. A., B. H. Becker, D. E. Burns, R. M. Huntley, S. M. Rood, P. Sinton, and T. H. Smith, 1994, *Preliminary Scoping Risk Assessment for Waste Pits, Trenches, and Soil Vaults at the Subsurface Disposal Area, Idaho National Engineering Laboratory*, EGG-WM-11181, Idaho National Engineering Laboratory.

Loomis, Guy G., James J. Jessmore, Jerry R. Weidner, Christopher M. Miller, and Allen L. Sehn, 2002, *Final Results Report for In Situ Grouting Technology for Application in Buried Transuranic Waste Sites, Volume 1, Technology Description and Treatability Study Results for Operable Unit 7-13/14*, INEEL/EXT-02-00233, Rev. 1, Idaho National Engineering and Environmental Laboratory.

Lopez, S. L., 2004, *Action Memorandum for the OU 7-13/14 Early Actions Beryllium Encapsulation Project*, DOE/NE-ID-11162, U.S. Department of Energy Idaho Operations Office.

Lowe, Darren, Wayne Downs, Sheldon Smith, and W. Vincent Wilding, 2003, *Mass Release of Chlorinated Solvents through Oil, Adsorbent, and Polyethylene Bagging at the Radioactive Waste Management Complex*, ICP/EXT-03-00057, Rev. 0, Idaho National Engineering and Environmental Laboratory, Idaho Completion Project.

Magnuson, Swen O. and A. Jeffrey Sondrup, 2006, *Subsurface Flow and Transport Modeling for the OU 7-13/14 Remedial Investigation and Feasibility Study*, ICP/EXT-05-01016, Idaho National Laboratory, Idaho Cleanup Project.

Maheras, Steven J., Arthur S. Rood, Swen O. Magnuson, Mary E. Sussman, and Rajiv N. Bhatt, 1997, *Addendum to Radioactive Waste Management Complex Low-Level Waste Radiological Performance Assessment*, INEEL/EXT-97-00462, (formerly EGG-WM-8773), Idaho National Engineering and Environmental Laboratory.

Matthern, Gretchen, 2005, *Preremedial Design Report of Remediation Options for OU 7-13/14*, ICP/EXT-04-00330, Rev. 0, Idaho National Laboratory, Idaho Cleanup Project.

McCarthy, James M., Roger R. Seitz, and Paul D. Ritter, 2001, *Performance Assessment and Composite Analysis Monitoring Program*, INEEL/EXT-01-00449, Rev. 0, Idaho National Engineering and Environmental Laboratory.

McElroy, D. L. and J. M. Hubbell, 1990, *Hydrologic and Physical Properties of Sediments at the Radioactive Waste Management Complex*, EGG-BG-9147, EG&G Idaho, Inc., Idaho Falls, ID.

McKenzie, M. Doug, Donald E. Sebo, Kirk M. Green, and Vivian G. Schultz, 2005, *Waste Information and Location Database for the OU 7-13/14 Project*, ICP/EXT-04-00271, Rev. 0, Idaho National Laboratory, Idaho Cleanup Project.

Miller, Eric C. and Mark D. Varvel, 2005, *Reconstructing the Past Disposal of 743-Series Waste in the Subsurface Disposal Area for Operable Unit 7-08, Organic Contamination in the Vadose Zone*, INEEL/EXT-01-00034, Rev. 1, Idaho National Laboratory, Idaho Cleanup Project.

Murray, R. L., 1994, *Understanding Radioactive Waste*, Richland, Washington: Battelle Press, Fourth Edition.

Nagata, P. K. and J. Banaee, 1996, *Estimation of the Underground Corrosion Rates for Low-Carbon Steels; Types 304 and 316 Stainless Steels; and Inconel 600, 601, and 718 Alloys at the Radioactive Waste Management Complex*, INEL 096/098, Idaho National Engineering Laboratory.

Oztunali, O. I. and G. W. Roles, 1985, *Update of Part 61 Impacts Analysis Methodology*, NUREG/CR 4370, Vol. 1, U.S. Nuclear Regulatory Commission.

Parsons, Alva M., Roger R. Seitz, and Karen N. Keck, 2005, *Annual Performance Assessment and Composite Analysis Review for the RWMC Low-Level Waste Disposal Facility FY 2004*, ICP/EXT-05-00771, Rev. 0, Idaho National Laboratory, Idaho Completion Project.

Plummer, M. A., L. C. Hull, and D. T. Fox, 2004, "Transport of Carbon-14 in a Large Unsaturated Column," *Vadose Zone Journal*, Vol. 3, No. 1, pp. 109–121.

Riley, R. G. and C. A. Lo Presti, 2004, *Recommended Parameter Values for INEEL Subsurface Disposal Area Source Release Modeling*, PNNL-14742, Pacific Northwest National Laboratory.

Rousseau, Joseph P., Edward R. Landa, John R. Nimmo, L. DeWayne Cecil, LeRoy L. Knobel, Pierre D. Glynn, Edward M. Kwicklis, Gary P. Curtis, Kenneth G. Stollenwerk, Steven R. Anderson, Roy C. Bartholomay, Clifford R. Bossong, and Brennan R. Orr, 2005, *Review of the Transport of Selected Radionuclides in the Interim Risk Assessment for the Radioactive Waste Management Complex, Waste Area Group 7 Operable Unit 7-13/14, Idaho National Engineering and Environmental Laboratory, Idaho*, USGS Scientific Investigations Report 2005-5026, prepared in cooperation with the U.S. Department of Energy, DOE/ID-22192, U.S. Geological Survey.

Sebo, Donald L., Carlan K. Mullen, Glen R. Longhurst, Michael L. Carboneau, and James W. Sterbentz, 2005, *Beryllium Waste Transuranic Inventory in the Subsurface Disposal Area Operable Unit 7-13/14*, INEEL/EXT-01-01678, Rev. 3, Idaho National Laboratory, Idaho Cleanup Project.

Sondrup, A. Jeffrey, Eric C. Miller, Edward H. Seabury, and Nick Josten, 2004, *Estimating Carbon Tetrachloride and Total Volatile Organic Compound Mass Remaining in Subsurface Disposal Area Pits*, ICP/EXT-04-00396, Rev. 0, Idaho National Engineering and Environmental Laboratory, Idaho Completion Project.

Sullivan, T. M., 1992, *Development of DUST: A Computer Code That Calculates Release Rates from LLW Disposal Unit*, BNL-NUREG-47118, Brookhaven National Laboratory, U.S. Nuclear Regulatory Commission.

Sullivan, T. M., 1993, *DUST-Disposal Unit Source Term Data Input Guide*, NUREG/CR-6041, BNL-NUREG-52375, Brookhaven National Laboratory.

Sullivan, T. M., 2006, *DUSTMS_D - Disposal Unit Source Term – Multiple Species – Distributed Failure Data Input Guide*, Rev. 1, BNL-75554-2006, Brookhaven National Laboratory, Upton, NY.

Walton, J. C., A. S. Rood, R. G. Baca and M. O. Otis, 1989, "Model for Estimation of Chlorinated Solvent Release from Waste Disposal Sites," *Journal of Hazardous Materials*, Vol. 21, pp. 15-34.

Zodtner, L. L. and R. F. Rogers, 1964, *Study of Unaccounted-For Plutonium Losses*, U.S. Department of Energy.

Appendix A

Nitrate and Chromate Conversion Factors

Appendix A

Nitrate and Chromate Conversion Factors

This appendix describes the derivation of conversion factors used to estimate the total amounts of nitrogen and chromium in the waste. This analysis was performed by Tom Bechtold on December 7, 2004, and was checked by Don Koeppen on December 7, 2004 and by Danny Anderson on January 14, 2005. Only two decimal places are shown for all values.

Inventories for nitrogen and chromium could not be extracted directly from Waste Inventory and Location Database because they are not listed as such. However, many compounds contain nitrate or chromate. Conversion factors were derived from the chemical formula and atomic weights of the constituent chemicals. Nitrate (nitrogen-bearing) and chromate (chromium-bearing) inventories were multiplied by these conversion factors to determine the amount of nitrate or chromate as total nitrogen or total chromium, respectively, buried in the waste. Table A-1 lists conversion factors used to estimate disposal inventories for nitrate and chromate (listed as total nitrogen and chromium).

Table A-1. Factors used to convert disposal quantity (grams) to amount of contaminant in the total waste stream (nitrate as total nitrogen and chromate as total chromium).

Contaminant	Conversion Factor
Aluminum nitrate nonahydrate	0.20
Copper nitrate	0.15
Mercury nitrate monohydrate	0.09
Nitric acid	0.22
Potassium nitrate	0.14
Sodium nitrate	0.16
Uranyl nitrate	0.07
Sodium dichromate	0.40
Potassium dichromate	0.35

Table A-2 lists the applicable chemical elements and their atomic weights, rounded to two decimal places. Table A-3 lists the nitrate- and chromate-containing compounds identified in the IRA (Table 5-7, Becker et al. 1998). The II oxidation state is assumed for mercury nitrate monohydrate, and all waters of hydrations are ignored.

Table A-2. Chemical elements and atomic weights.

Element	Symbol	Atomic Weight
Aluminum	Al	26.98
Chromium	Cr	52.00
Copper	Cu	63.55
Hydrogen	H	1.01
Mercury	Hg	200.59
Nitrogen	N	14.01
Potassium	K	39.10
Sodium	Na	22.99
Oxygen	O	16.00
Uranium	U	238.03

Table A-3. Nitrate- and chromate-containing contaminant compounds.

Contaminant	Formula
Aluminum nitrate nonahydrate	$AL(NO_3)_3 \cdot 9H_2O$
Copper nitrate	$Cu(NO_3)_2$
Mercury nitrate monohydrate	$Hg(NO_3)_2 \cdot H_2O$
Nitric acid	HNO_3
Potassium nitrate	KNO_3
Sodium nitrate	$NaNO_3$
Uranyl nitrate	$UO_2(NO_3)_2$
Sodium dichromate	$Na_2Cr_2O_7 \cdot 2H_2O$
Potassium dichromate	$K_2Cr_2O_7$

Using the compound formula and the molecular weights, and neglecting the water of hydration, the formula weights are calculated as follows:

$AL(NO_3)_3$	=	$26.98 + 3[14.01 + (3 \cdot 16.00)]$	=	213.01
$Cu(NO_3)_2$	=	$63.55 + 2[14.01 + (3 \cdot 16.00)]$	=	187.57
$Hg(NO_3)_2$	=	$200.59 + 2[14.01 + (3 \cdot 16.00)]$	=	324.61
HNO_3	=	$1.01 + [14.01 + (3 \cdot 16.00)]$	=	63.02
KNO_3	=	$39.10 + [14.01 + (3 \cdot 16.00)]$	=	101.11
$NaNO_3$	=	$22.99 + [14.01 + (3 \cdot 16.00)]$	=	85.00
$UO_2(NO_3)_2$	=	$[238.03 + (2 \cdot 16.00)] + 2[14.01 + (3 \cdot 16.00)]$	=	394.05
$Na_2Cr_2O_7$	=	$(2 \cdot 22.99) + (2 \cdot 52.00) + (7 \cdot 16.00)$	=	261.98
$K_2Cr_2O_7$	=	$(2 \cdot 39.10) + (2 \cdot 52.00) + (7 \cdot 16.00)$	=	294.20

The nitrate and chromate conversion factors, then, are the mass fractions of nitrogen or chromium, calculated by dividing the formula weight of nitrogen or chromium in the compound by the entire formula weight of the compound, as follows:

$AL(NO_3)_3$	=	$(3 \cdot 14.01)/213.01$	=	0.20
$Cu(NO_3)_2$	=	$(2 \cdot 14.01)/187.57$	=	0.15
$Hg(NO_3)_2$	=	$(2 \cdot 14.01)/324.61$	=	0.09
HNO_3	=	$14.01/63.02$	=	0.22
KNO_3	=	$14.01/101.11$	=	0.14
$NaNO_3$	=	$14.01/85.00$	=	0.16
$UO_2(NO_3)_2$	=	$(2 \cdot 14.01)/394.05$	=	0.07
$Na_2Cr_2O_7$	=	$(2 \cdot 52.00)/261.98$	=	0.40
$K_2Cr_2O_7$	=	$(2 \cdot 52.00)/294.20$	=	0.35

Table A-4 compares the conversion factors calculated recently, for the RI/BRA, with those presented in the IRA. Seven of the ten conversion factors used in the IRA were derived using the chemical formula and the molecular weights and matched the new factors; the remaining three were not derived using the chemical formula and the molecular weights and do not match the new factors. It was recommended and accepted that the new factors be used for the RI/BRA. In all cases, revisions to the conversion factors are conservative.

Table A-4. Comparison of remedial investigation and baseline risk assessment calculated conversion factors with those in the Interim Risk Assessment. (Changes are bolded.)

Contaminant	IRA Conversion Factor	RI/BRA Conversion Factor
Aluminum nitrate nonahydrate	0.02	0.20
Copper nitrate	**0.12**	**0.15**
Mercury nitrate monohydrate	**0.08**	**0.09**
Nitric acid	0.22	0.22
Potassium nitrate	0.14	0.14
Sodium nitrate	**0.14**	**0.16**
Uranyl nitrate	0.07	0.07
Sodium dichromate	0.40	0.40
Potassium dichromate	0.35	0.35

IRA = Interim Risk Assessment (Becker et al. 1998)
RI/BRA = Remedial Investigation Baseline Risk Assessment (Holdren et al. 2005, Draft)

Appendix B

Source Allocations by Year

Appendix B

Source Allocation by Year

Table B-1. Inventory allocated to T1-10 by year.

T1-10	Inventory		Consecutive Year of Burial						
Nuclide	Year 1	Years	1	2	3	4	5	6	7
Am-241	1953	7	9.421E-07	1.779E+03	4.735E+03	6.443E+03	7.840E+03	2.017E+00	9.725E-03
Np-237	1953	7	4.147E-12	3.383E-10	3.574E-08	3.531E-06	8.955E-04	1.363E-03	3.776E-05
U-233	1953	7	3.737E-10	3.047E-08	4.270E-08	3.156E-07	5.633E-07	0.000E+00	0.000E+00
Th-229	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.745E-11	3.166E-09	1.411E-11
Am-243	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.741E-05	1.122E-02	4.796E-05
Pu-239c	1953	7	0.000E+00	2.175E+00	5.533E+00	7.419E+00	9.070E+00	0.000E+00	0.000E+00
Pu-239	1953	7	5.538E-08	5.660E+01	1.440E+02	1.931E+02	2.361E+02	1.815E-01	0.000E+00
U-235	1953	7	2.919E-14	9.017E-03	1.875E-02	2.391E-02	3.198E-02	9.301E-01	2.210E-05
Pa-231	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.340E-09	3.848E-07	1.628E-09
Ac-227	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.340E-09	3.848E-07	1.628E-09
Pu-240c	1953	7	0.000E+00	4.866E-01	1.238E+00	1.660E+00	2.030E+00	0.000E+00	0.000E+00
Pu-240	1953	7	3.465E-08	1.267E+01	3.222E+01	4.321E+01	5.283E+01	2.124E-01	6.269E-04
U-236	1953	7	1.528E-12	4.592E-02	7.392E-02	8.951E-02	8.276E-02	6.023E-02	8.347E-05
Th-232	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.045E-14	1.042E-11	5.745E-14
Ra-228	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.948E-12	2.244E-10	9.518E-13
Pu-238	1953	7	3.741E-07	1.805E+00	4.593E+00	6.172E+00	1.108E+01	1.683E+01	1.320E-01
U-238	1953	7	7.182E-12	7.642E-01	1.509E+00	2.027E+00	1.758E+00	4.828E-06	4.164E-07
U-234	1953	7	4.379E-10	9.253E-01	1.618E+00	1.746E+00	1.737E+00	2.403E-02	6.163E-05
Th-230	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.225E-09	0.000E+00	0.000E+00
Ra-226	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.237E-10	0.000E+00	0.000E+00

Table B-1. (continued).

T1-10	Inventory		Consecutive Year of Burial						
Nuclide	Year 1	Years	1	2	3	4	5	6	7
Pb-210	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.275E-12	0.000E+00	0.000E+00
Tc-99A	1953	7	0.000E+00	1.918E-08	1.875E-05	2.433E-06	8.199E-07	1.538E-06	1.532E-03
I-129A	1953	7	0.000E+00	6.570E-11	3.560E-08	4.827E-09	1.548E-09	4.032E-09	1.152E-06
Cl-36A	1953	7	0.000E+00	2.722E-07	1.475E-04	3.515E-05	1.085E-05	1.839E-05	2.369E-06
Tc-99B	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129B	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36B	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99F	1953	7	0.000E+00	0.000E+00	1.047E-04	2.596E-02	0.000E+00	0.000E+00	0.000E+00
I-129F	1953	7	0.000E+00	0.000E+00	1.796E-09	1.796E-07	4.500E-05	0.000E+00	0.000E+00
Cl-36F	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99R	1953	7	0.000E+00	1.018E-04	1.558E-04	0.000E+00	1.301E-04	4.695E-05	2.828E-05
I-129R	1953	7	0.000E+00	4.017E-07	6.199E-07	0.000E+00	5.133E-07	1.910E-07	3.794E-08
Cl-36R	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99V	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129V	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36V	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99W	1953	7	1.488E-06	1.160E-05	2.784E-06	3.096E-05	7.117E-03	8.016E-01	5.059E-03
I-129W	1953	7	5.980E-09	4.663E-08	1.119E-08	1.245E-07	1.181E-05	1.283E-03	8.164E-06
Cl-36W	1953	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.856E-10
C-14A									
C-14B									
C-14F									
C-14R									
C-14W									

Table B-1. (continued).

T1-10	Inventory		Consecutive Year of Burial						
Nuclide	Year 1	Years	1	2	3	4	5	6	7
Nb-94	1954	6	8.715E-06	4.722E-03	5.680E-04	1.843E-04	5.268E-04	1.541E+00	
Sr-90	1954	6	6.436E-06	1.098E-02	7.503E-01	1.877E+02	4.966E-04	4.776E+00	
N-14	1953	1	0.000E+00						
Cr-52	1953	1	0.000E+00						
CT-154	1954	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
MC-85	1954	4	6.146E+04	1.612E+05	2.182E+05	2.640E+05			
PCE-166	1954	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
DIO-88	1954	4	8.338E+02	2.052E+03	2.817E+03	2.916E+03			

Units:
- Ci for radionuclides
- gm for VOCs and inorganics (non-radionuclides)

Suffixes:
- A = activated metal
- B = beryllium blocks
- c = colloidal
- F = fuel-like materials
- R = resins
- V = Vycor
- W = surface wash

Table B-2. Inventory allocated to Acid Pit by year.

Acid Pit	Inventory		Consecutive Year of Burial					
Nuclide	Year 1	Years	1	2	3	4	5	6
Am-241	1957	5	4.042E-04	0.000E+00	9.451E-06	0.000E+00	1.455E-10	
Np-237	1957	5	2.730E-07	0.000E+00	6.345E-09	0.000E+00	0.000E+00	
U-233	1957	5	4.015E-11	0.000E+00	2.363E-11	0.000E+00	1.180E-13	
Th-229	1957	5	6.344E-13	0.000E+00	1.474E-14	0.000E+00	0.000E+00	
Am-243	1954	6	0.000E+00	0.000E+00	0.000E+00	2.129E-06	0.000E+00	5.226E-08
Pu-239c	1954	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	1954	6	0.000E+00	0.000E+00	0.000E+00	5.246E-05	0.000E+00	1.291E-06
U-235	1954	6	6.700E-04	1.200E-03	3.300E-04	6.002E-05	5.660E-05	4.293E-10
Pa-231	1954	6	0.000E+00	0.000E+00	0.000E+00	7.299E-11	0.000E+00	1.792E-12
Ac-227	1954	6	0.000E+00	0.000E+00	0.000E+00	7.299E-11	0.000E+00	1.792E-12
Pu-240c	1954	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-240	1954	6	4.030E-05	0.000E+00	9.914E-07	0.000E+00	0.000E+00	0.000E+00
U-236	1954	6	4.334E-08	0.000E+00	1.064E-09	0.000E+00	0.000E+00	0.000E+00
Th-232	1954	6	1.977E-15	0.000E+00	4.853E-17	0.000E+00	0.000E+00	0.000E+00
Ra-228	1954	6	4.258E-14	0.000E+00	1.045E-15	0.000E+00	0.000E+00	0.000E+00
Pu-238	1954	6	0.000E+00	0.000E+00	0.000E+00	3.373E-03	0.000E+00	7.840E-05
U-238	1954	6	2.700E-02	6.300E-02	6.900E-03	1.300E-03	8.300E-04	2.262E-11
U-234	1954	6	1.900E-02	3.400E-02	9.500E-03	1.703E-03	1.660E-03	6.533E-08
Th-230	1954	6	0.000E+00	0.000E+00	0.000E+00	4.854E-08	5.611E-06	2.382E-08
Ra-226	1954	6	0.000E+00	0.000E+00	0.000E+00	1.283E-08	1.483E-06	6.281E-09
Pb-210	1954	6	0.000E+00	0.000E+00	0.000E+00	9.014E-11	1.042E-08	4.743E-11
Tc-99A	1957	3	0.000E+00	0.000E+00	0.000E+00			
I-129A	1957	3	0.000E+00	0.000E+00	0.000E+00			

Table B-2. (continued).

Acid Pit	Inventory		Consecutive Year of Burial					
Nuclide	Year 1	Years	1	2	3	4	5	6
Cl-36A	1957	3	0.000E+00	0.000E+00	0.000E+00			
Tc-99B	1957	3	0.000E+00	0.000E+00	0.000E+00			
I-129B	1957	3	0.000E+00	0.000E+00	0.000E+00			
Cl-36B	1957	3	0.000E+00	0.000E+00	0.000E+00			
Tc-99F	1957	3	0.000E+00	0.000E+00	0.000E+00			
I-129F	1957	3	0.000E+00	0.000E+00	0.000E+00			
Cl-36F	1957	3	0.000E+00	0.000E+00	0.000E+00			
Tc-99R	1957	3	0.000E+00	0.000E+00	0.000E+00			
I-129R	1957	3	0.000E+00	0.000E+00	0.000E+00			
Cl-36R	1957	3	0.000E+00	0.000E+00	0.000E+00			
Tc-99V	1957	3	0.000E+00	0.000E+00	0.000E+00			
I-129V	1957	3	0.000E+00	0.000E+00	0.000E+00			
Cl-36V	1957	3	0.000E+00	0.000E+00	0.000E+00			
Tc-99W	1957	3	1.606E-04	0.000E+00	3.816E-06			
I-129W	1957	3	2.433E-07	0.000E+00	6.309E-09			
Cl-36W	1957	3	0.000E+00	0.000E+00	0.000E+00			
C-14A								
C-14B								
C-14F								
C-14R								
C-14W								
Nb-94	1954	1	0.000E+00					
Sr-90	1954	1	0.000E+00					
N-14	1954	6	8.288E+06	8.288E+06	8.288E+06	8.288E+06	8.288E+06	8.288E+06

Table B-2. (continued).

Acid Pit	Inventory		Consecutive Year of Burial					
Nuclide	Year 1	Years	1	2	3	4	5	6
Cr-52	1954	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CT-154	1954	1	0.000E+00					
MC-85	1954	1	0.000E+00					
PCE-166	1954	1	0.000E+00					
DIO-88	1954	1	0.000E+00					

Units:
- Ci for radionuclides
- gm for VOCs and inorganics (non-radionuclides)

Suffixes:
- A = activated metal
- B = beryllium blocks
- c = colloidal
- F = fuel-like materials
- R = resins
- V = Vycor
- W = surface wash

Table B-3. Inventory allocated to P1-2&T11-15 by year.

P1-2&T11-15	Inventory		Consecutive Year of Burial						
Nuclide	Year 1	Years	1	2	3	4	5	6	7
Am-241	1957	7	2.200E+03	1.186E+04	1.113E+04	1.931E+04	1.874E+04	9.993E+03	3.820E+03
Np-237	1957	7	0.000E+00	2.210E-10	1.150E-04	5.820E-07	0.000E+00	2.451E-05	5.472E-08
U-233	1957	7	0.000E+00	2.740E-07	4.798E-07	8.560E-11	0.000E+00	2.307E-08	1.051E-10
Th-229	1957	7	0.000E+00	0.000E+00	2.043E-10	1.352E-12	0.000E+00	7.843E-14	1.227E-15
Am-243	1957	7	0.000E+00	0.000E+00	7.333E-04	4.782E-06	0.000E+00	1.306E-05	8.064E-10
Pu-239c	1957	7	1.743E+01	5.147E+01	1.539E+02	8.806E+01	2.178E+02	1.502E+02	4.746E+01
Pu-239	1957	7	4.536E+02	1.340E+03	4.005E+03	2.296E+03	5.705E+03	3.919E+03	1.529E+03
U-235	1957	7	1.568E-02	1.409E-01	3.582E-02	2.140E-01	2.135E-01	8.338E-02	2.003E-02
Pa-231	1957	7	0.000E+00	0.000E+00	2.514E-08	1.639E-10	0.000E+00	2.572E-10	9.382E-20
Ac-227	1957	7	0.000E+00	0.000E+00	2.514E-08	1.639E-10	0.000E+00	2.572E-10	9.382E-20
Pu-240c	1957	7	3.900E+00	1.152E+01	3.443E+01	1.971E+01	4.873E+01	3.362E+01	1.062E+01
Pu-240	1957	7	1.015E+02	2.998E+02	8.962E+02	5.129E+02	1.268E+03	8.750E+02	5.707E+02
U-236	1957	7	2.151E-02	5.800E-02	4.326E-02	6.688E-03	9.472E-03	2.347E-03	1.050E-02
Th-232	1957	7	0.000E+00	0.000E+00	6.860E-13	4.200E-03	3.348E-02	8.545E-03	1.036E+00
Ra-228	1957	7	0.000E+00	0.000E+00	1.466E-11	9.563E-14	0.000E+00	5.533E-15	3.483E-18
Pu-238	1957	7	1.447E+01	4.273E+01	1.289E+02	7.310E+01	1.808E+02	1.247E+02	3.939E+01
U-238	1957	7	4.047E-01	2.719E+00	2.859E+00	3.322E+00	3.360E+00	2.734E+00	8.753E-01
U-234	1957	7	5.051E-01	1.806E+00	1.940E+00	1.306E+00	4.209E+00	1.206E+00	8.119E-01
Th-230	1957	7	0.000E+00	0.000E+00	3.609E-07	2.396E-09	0.000E+00	4.430E-08	1.002E-13
Ra-226	1957	7	0.000E+00	0.000E+00	9.538E-08	6.333E-10	1.766E+01	3.656E+00	2.934E+00
Pb-210	1957	7	0.000E+00	0.000E+00	6.702E-10	4.450E-12	0.000E+00	2.568E-13	2.541E-21
Tc-99A	1958	6	0.000E+00	1.910E-03	0.000E+00	0.000E+00	2.441E-03	0.000E+00	
I-129A	1958	6	0.000E+00	1.265E-06	0.000E+00	0.000E+00	4.524E-06	0.000E+00	

Table B-3. (continued).

P1-2&T11-15	Inventory		Consecutive Year of Burial						
Nuclide	Year 1	Years	1	2	3	4	5	6	7
Cl-36A	1958	6	0.000E+00	3.661E-04	0.000E+00	0.000E+00	9.856E-07	0.000E+00	
Tc-99B	1958	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
I-129B	1958	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Cl-36B	1958	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Tc-99F	1958	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
I-129F	1958	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Cl-36F	1958	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Tc-99R	1958	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
I-129R	1958	6	4.463E-10	7.364E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Cl-36R	1958	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Tc-99V	1958	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
I-129V	1958	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Cl-36V	1958	6	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Tc-99W	1958	6	7.331E-05	5.174E-02	3.423E-04	0.000E+00	8.230E-05	4.423E-06	
I-129W	1958	6	2.947E-07	8.419E-05	5.465E-07	0.000E+00	1.597E-07	8.138E-09	
Cl-36W	1958	6	0.000E+00	1.554E-11	0.000E+00	0.000E+00	2.044E-09	4.115E-06	
C-14A									
C-14B									
C-14F									
C-14R									
C-14W									
Nb-94	1959	5	7.291E-02	0.000E+00	0.000E+00	5.547E-07	0.000E+00		
Sr-90	1959	5	4.838E+00	0.000E+00	6.695E+02	3.245E+02	5.405E+01		
N-14	1961	3	8.443E+03	5.213E+03	1.591E+03				

Table B-3. (continued).

P1-2&T11-15	Inventory		Consecutive Year of Burial						
Nuclide	Year 1	Years	1	2	3	4	5	6	7
Cr-52	1961	3	0.000E+00	0.000E+00	0.000E+00				
CT-154	1957	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MC-85	1957	7	9.106E+04	4.105E+05	3.789E+05	6.528E+05	6.089E+05	3.306E+05	1.446E+05
PCE-166	1957	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
DIO-88	1957	7	2.597E+03	5.648E+03	5.844E+03	6.128E+03	6.837E+03	4.588E+03	2.455E+03

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-4. Inventory allocated to T16-41 by year.

T16-41	Inventory		Consecutive Year of Burial							
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8
Am-241	1959	8	1.061E-03	2.304E+00	9.874E-01	3.784E+00	4.242E+02	2.455E+00	1.264E+00	7.793E-01
Np-237	1959	8	1.433E-06	9.036E-04	5.231E-03	4.047E-04	3.853E-02	2.222E-03	8.561E-04	1.433E-03
U-233	1959	8	2.742E-07	2.947E-04	1.699E-01	1.017E-01	1.417E-05	2.788E-01	3.881E-05	1.255E-05
Th-229	1959	8	9.680E-13	8.552E-11	2.508E-10	2.492E-10	1.033E-09	2.087E-10	1.558E-10	9.091E-11
Am-243	1959	8	3.365E-06	2.586E-04	6.655E-04	4.624E-04	1.563E-03	9.056E-04	5.171E-04	1.910E-04
Pu-239c	1959	8	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.120E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	1959	8	1.832E-04	3.867E+00	8.778E-01	3.030E+00	5.995E+01	1.405E+01	2.232E+00	6.236E+00
U-235	1959	8	7.227E-07	3.347E-02	2.741E-02	2.786E-01	7.321E-02	4.429E-03	1.969E-02	3.813E-03
Pa-231	1959	8	1.149E-10	9.673E-08	2.021E-08	2.666E-07	5.316E-08	2.933E-08	2.730E-08	6.238E-08
Ac-227	1959	8	1.149E-10	9.673E-08	2.021E-08	2.666E-07	5.316E-08	2.933E-08	2.730E-08	6.238E-08
Pu-240c	1959	8	4.744E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-240	1959	8	1.211E-04	2.578E-01	2.991E-01	1.299E+00	1.497E+01	1.065E+00	4.172E-01	1.773E-01
U-236	1959	8	2.710E-06	2.490E-03	1.347E-02	6.160E-03	1.020E-01	7.173E-03	2.650E-03	4.488E-03
Th-232	1959	8	3.538E-15	1.500E-01	3.561E-02	2.374E-05	7.413E-05	1.945E-05	4.500E-01	3.000E-01
Ra-228	1959	8	6.707E-14	4.834E-12	1.211E-11	8.992E-12	1.538E-11	1.360E-11	9.821E-12	3.591E-12
Pu-238	1959	8	7.095E-03	2.313E+00	1.057E+01	1.767E+00	7.677E+01	4.060E+00	2.176E+00	4.645E+00
U-238	1959	8	7.413E-08	2.635E-01	3.895E-01	1.537E+00	1.039E-01	1.542E-02	3.007E-01	3.791E-04
U-234	1959	8	4.446E-06	7.877E-01	3.963E-01	5.953E+00	1.572E-01	9.964E-02	4.072E-01	9.086E-02
Th-230	1959	8	1.677E-09	1.910E-05	2.604E-07	6.374E-05	1.647E-06	1.604E-06	3.073E-06	2.850E-06
Ra-226	1959	8	4.426E-10	4.889E-04	1.002E+01	4.333E-01	2.692E+01	2.009E-01	6.002E-04	2.910E-08
Pb-210	1959	8	3.110E-12	8.779E-10	4.593E-10	1.692E-09	5.982E-10	6.069E-10	4.999E-10	3.028E-10
Tc-99A	1959	8	8.115E-05	4.522E-02	1.776E-02	1.653E-01	7.532E-02	6.395E-04	1.630E-02	1.185E-02
I-129A	1959	8	5.407E-08	8.699E-06	6.312E-06	2.609E-04	1.288E-04	7.927E-05	3.503E-05	3.359E-05

Table B-4. (continued).

T16-41	Inventory		Consecutive Year of Burial							
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8
Cl-36A	1959	8	5.605E-05	3.459E-04	2.116E-04	2.861E-04	6.914E-04	5.950E-04	1.523E-02	3.102E-02
Tc-99B	1959	8	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129B	1959	8	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36B	1959	8	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99F	1959	8	0.000E+00	1.262E-06	3.394E-01	2.597E-02	5.456E-01	1.260E-01	2.693E-02	8.534E-02
I-129F	1959	8	0.000E+00	9.797E-10	5.571E-04	7.977E-05	9.655E-04	1.711E-04	3.159E-05	1.879E-04
Cl-36F	1959	8	0.000E+00	1.010E-11	6.110E-08	8.420E-10	2.084E-07	2.371E-04	1.459E-05	1.099E-05
Tc-99R	1959	8	0.000E+00	1.067E-01	1.067E-01	1.067E-01	1.067E-01	1.067E-01	1.109E-01	2.534E-02
I-129R	1959	8	0.000E+00	2.653E-03	2.653E-03	2.653E-03	2.653E-03	2.653E-03	2.670E-03	6.302E-04
Cl-36R	1959	8	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99V	1959	8	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129V	1959	8	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36V	1959	8	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99W	1959	8	7.019E-04	1.173E+00	1.061E-01	7.020E-02	2.327E+00	1.431E-01	1.399E-01	5.343E-02
I-129W	1959	8	2.124E-06	4.508E-03	2.391E-04	1.506E-04	3.813E-03	2.409E-04	3.504E-04	1.077E-04
Cl-36W	1959	8	5.552E-12	6.364E-06	8.967E-08	2.733E-07	2.573E-07	3.591E-07	4.048E-07	1.256E-06
C-14A										
C-14B										
C-14F										
C-14R										
C-14W										
Nb-94	1959	8	6.449E-02	2.310E-01	1.078E+01	1.326E+00	1.036E+01	5.496E-01	1.904E+01	1.999E+00
Sr-90	1959	8	2.745E-01	3.261E+01	2.308E+03	1.496E+03	4.127E+03	8.005E+02	1.777E+02	8.960E+02
N-14	1961	3	5.366E+00	7.155E+00	2.773E+01					

Table B-4. (continued).

T16-41	Inventory		Consecutive Year of Burial							
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8
Cr-52	1961	3	0.000E+00	0.000E+00	0.000E+00					
CT-154	1960	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
MC-85	1960	7	0.000E+00	0.000E+00	0.000E+00	1.581E+04	0.000E+00	0.000E+00	0.000E+00	
PCE-166	1960	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
DIO-88	1960	7	4.159E+02	3.946E+00	6.905E+00	4.082E+02	2.407E+01	6.583E+01	3.896E+01	

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-5. Inventory allocated to P3 by year.

P3	Inventory		Consecutive Year of Burial	
Nuclide	Year 1	Years	1	2
Am-241	1961	2	9.133E-03	2.150E+03
Np-237	1961	2	3.458E-06	2.363E-05
U-233	1961	2	3.250E-03	3.421E-09
Th-229	1961	2	3.443E-12	1.539E-12
Am-243	1961	2	1.523E-05	4.006E-06
Pu-239c	1961	2	0.000E+00	1.235E+02
Pu-239	1961	2	6.994E-03	3.213E+03
U-235	1961	2	2.946E-06	7.448E-02
Pa-231	1961	2	5.108E-10	1.260E-10
Ac-227	1961	2	5.108E-10	1.260E-10
Pu-240c	1961	2	0.000E+00	2.763E+01
Pu-240	1961	2	3.091E-03	7.191E+02
U-236	1961	2	6.183E-06	4.879E-03
Th-232	1961	2	2.002E-09	3.862E-08
Ra-228	1961	2	2.896E-13	7.494E-14
Pu-238	1961	2	2.119E-02	1.025E+02
U-238	1961	2	2.083E-05	6.253E-01
U-234	1961	2	9.550E-05	6.775E-01
Th-230	1961	2	8.646E-09	1.879E-09
Ra-226	1961	2	1.609E-09	3.900E-03
Pb-210	1961	2	1.129E-11	3.413E-12
Tc-99A	1961	2	1.643E-04	1.125E-06
I-129A	1961	2	2.996E-07	1.845E-09
Cl-36A	1961	2	6.723E-09	1.254E-13
Tc-99B	1961	2	0.000E+00	0.000E+00
I-129B	1961	2	0.000E+00	0.000E+00
Cl-36B	1961	2	0.000E+00	0.000E+00
Tc-99F	1961	2	0.000E+00	0.000E+00
I-129F	1961	2	0.000E+00	0.000E+00
Cl-36F	1961	2	0.000E+00	0.000E+00
Tc-99R	1961	2	0.000E+00	0.000E+00
I-129R	1961	2	0.000E+00	0.000E+00
Cl-36R	1961	2	0.000E+00	0.000E+00
Tc-99V	1961	2	0.000E+00	0.000E+00

Table B-5. (continued).

P3	Inventory		Consecutive Year of Burial	
Nuclide	Year 1	Years	1	2
I-129V	1961	2	0.000E+00	0.000E+00
Cl-36V	1961	2	0.000E+00	0.000E+00
Tc-99W	1961	2	8.962E-04	2.046E-03
I-129W	1961	2	1.709E-06	3.535E-06
Cl-36W	1961	2	3.203E-10	6.316E-09
C-14A				
C-14B				
C-14F				
C-14R				
C-14W				
Nb-94	1961	2	1.388E-04	6.002E-06
Sr-90	1961	2	1.482E+00	7.460E-03
N-14	1962	1	7.796E+03	
Cr-52	1962	1	0.000E+00	
CT-154	1961	2	0.000E+00	0.000E+00
MC-85	1961	2	0.000E+00	1.016E+05
PCE-166	1961	2	0.000E+00	0.000E+00
DIO-88	1961	2	7.102E+00	4.007E+03

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-6. Inventory allocated to P4 by year.

P4	Inventory		Consecutive Year of Burial			ARP Inventory Included (B4ng)	
Nuclide	Year 1	Years	1	2	3	4	5
Am-241	1963	5	9.718E+03	8.968E+03	1.939E+03	7.754E+03	2.312E+04
Np-237	1963	5	2.013E-05	4.957E-08	1.340E-10	4.873E-06	1.088E-06
U-233	1963	5	6.985E-09	6.274E-12	5.060E-14	7.229E-10	2.277E-10
Th-229	1963	5	3.990E-15	7.782E-14	0.000E+00	2.461E-13	1.426E-12
Am-243	1963	5	1.071E-05	2.744E-07	7.120E-11	2.319E-06	5.053E-06
Pu-239c	1963	5	1.788E+02	3.170E+01	4.771E+00	9.933E+01	1.623E+02
Pu-239	1963	5	4.808E+03	8.250E+02	1.242E+02	2.585E+03	4.225E+03
U-235	1963	5	5.161E-02	3.944E-02	1.303E-03	4.904E-02	1.500E-01
Pa-231	1963	5	2.077E-10	9.393E-12	1.380E-15	5.767E-11	1.732E-10
Ac-227	1963	5	2.077E-10	9.393E-12	1.380E-15	5.767E-11	1.732E-10
Pu-240c	1963	5	4.001E+01	6.929E+00	1.072E+00	1.955E+01	3.708E+01
Pu-240	1963	5	1.196E+03	1.803E+02	2.790E+01	5.089E+02	9.652E+02
U-236	1963	5	4.258E-02	5.043E-02	3.194E-03	1.512E-02	3.150E-02
Th-232	1963	5	2.279E-01	2.605E-16	0.000E+00	5.565E-08	1.523E-08
Ra-228	1963	5	2.740E-16	5.474E-15	0.000E+00	1.715E-14	1.011E-13
Pu-238	1963	5	1.484E+02	2.770E+01	4.106E+00	7.530E+01	1.348E+02
U-238	1963	5	1.306E+00	1.479E+00	2.290E-01	6.091E+00	1.720E+01
U-234	1963	5	1.077E+00	1.136E+00	5.474E-02	7.346E-01	9.059E-01
Th-230	1963	5	3.696E-08	1.392E-10	2.460E-13	5.662E-09	2.527E-09
Ra-226	1963	5	2.742E+00	3.629E-11	1.880E-16	8.092E-07	6.740E-10
Pb-210	1963	5	1.270E-14	2.550E-13	0.000E+00	7.959E-13	4.692E-12
Tc-99A	1963	5	2.043E-03	1.126E-06	0.000E+00	1.425E-05	2.813E-09
I-129A	1963	5	3.785E-06	2.040E-09	2.520E-11	5.399E-07	2.981E-11
Cl-36A	1963	5	2.508E-15	1.255E-13	0.000E+00	1.588E-12	3.135E-16
Tc-99B	1963	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129B	1963	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36B	1963	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99F	1963	5	0.000E+00	1.035E-07	1.360E-08	2.893E-04	1.360E-08
I-129F	1963	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36F	1963	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99R	1963	5	8.814E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129R	1963	5	3.478E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36R	1963	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Table B-6. (continued).

P4	Inventory		Consecutive Year of Burial			ARP Inventory Included (B4ng)	
Nuclide	Year 1	Years	1	2	3	4	5
Tc-99V	1963	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129V	1963	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36V	1963	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99W	1963	5	1.405E-06	1.961E-05	7.331E-11	3.230E-04	4.333E-04
I-129W	1963	5	2.265E-09	3.127E-08	2.947E-13	6.394E-07	7.279E-07
Cl-36W	1963	5	8.854E-07	0.000E+00	0.000E+00	8.845E-09	2.431E-09
C-14A							
C-14B							
C-14F							
C-14R							
C-14W							
Nb-94							
Sr-90							
N-14							
Cr-52							
CT-154	1963	5	0.000E+00	0.000E+00	0.000E+00	3.873E+06	3.441E+08
MC-85	1963	5	3.655E+05	5.020E+05	9.640E+04	4.102E+05	1.820E+06
PCE-166	1963	5	0.000E+00	0.000E+00	0.000E+00	6.034E+05	4.272E+07
DIO-88	1963	5	1.097E+04	8.933E+03	1.398E+03	1.438E+04	7.541E+05

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-7. Inventory allocated to P4R by year, after or if not affected by Accelerated Retrieval Project.

P4R	Inventory		Consecutive Year of Burial			ARP Inventory Retrieved (B)	
Nuclide	Year 1	Years	1	2	3	4	5
Am-241	2004	1	3.319E+04				
Np-237	2004	1	6.041E-01				
U-233	2004	1	4.901E-05				
Th-229	2004	1	5.780E-08				
Am-243	2004	1	1.763E-05				
Pu-239c	2004	1	9.235E+01				
Pu-239	2004	1	9.233E+03				
U-235	2004	1	2.896E-01				
Pa-231	2004	1	2.156E-04				
Ac-227	2004	1	8.989E-05				
Pu-240c	2004	1	2.081E+01				
Pu-240	2004	1	2.185E+03				
U-236	2004	1	1.209E-01				
Th-232	2004	1	2.245E-01				
Ra-228	2004	1	2.098E-01				
Pu-238	2004	1	2.122E+02				
U-238	2004	1	1.429E+01				
U-234	2004	1	2.122E+00				
Th-230	2004	1	1.376E-03				
Ra-226	2004	1	2.664E+00				
Pb-210	2004	1	1.897E+00				
Tc-99A							
I-129A							
Cl-36A							
Tc-99B							
I-129B							
Cl-36B							
Tc-99F							
I-129F							
Cl-36F							
Tc-99R							
I-129R							
Cl-36R							

Table B-7. (continued).

P4R	Inventory		Consecutive Year of Burial			ARP Inventory Retrieved (B)	
Nuclide	Year 1	Years	1	2	3	4	5
Tc-99V							
I-129V							
Cl-36V							
Tc-99W							
I-129W							
Cl-36W							
C-14A							
C-14B							
C-14F							
C-14R							
C-14W							
Nb-94	1963	5	1.277E-07	6.006E-06	5.060E-14	7.599E-05	1.501E-08
Sr-90	1963	5	2.071E+02	8.101E-03	8.370E-05	1.810E+00	1.024E-04
N-14	1963	5	1.082E+04	0.000E+00	0.000E+00	0.000E+00	4.480E+06
Cr-52	1963	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.118E+04
CT-154	2004	1	0.000E+00				
MC-85	2004	1	0.000E+00				
PCE-166	2004	1	0.000E+00				
DIO-88	2004	1	0.000E+00				

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-8. Inventory allocated to P5 by year.

P5	Inventory		Consecutive Year of Burial		
Nuclide	Year 1	Years	1	2	3
Am-241	1964	3	2.490E+02	1.000E+04	1.853E+04
Np-237	1964	3	6.608E-07	1.570E-10	8.528E-05
U-233	1964	3	1.509E-10	3.742E-01	8.476E-02
Th-229	1964	3	7.498E-17	3.633E-16	3.822E-12
Am-243	1964	3	3.494E-07	1.287E-09	8.909E-06
Pu-239c	1964	3	1.358E+01	5.261E+01	9.026E+01
Pu-239	1964	3	3.534E+02	1.369E+03	2.349E+03
U-235	1964	3	5.272E-02	3.560E-02	2.399E-01
Pa-231	1964	3	6.771E-12	4.414E-14	2.622E-10
Ac-227	1964	3	6.771E-12	4.414E-14	2.622E-10
Pu-240c	1964	3	3.086E+00	1.176E+01	2.038E+01
Pu-240	1964	3	8.032E+01	3.060E+02	5.305E+02
U-236	1964	3	3.522E-02	5.715E-02	6.398E-02
Th-232	1964	3	1.396E-18	1.196E-18	2.364E-07
Ra-228	1964	3	2.128E-19	2.575E-17	1.543E-13
Pu-238	1964	3	1.001E+01	4.295E+01	7.294E+01
U-238	1964	3	3.399E-01	2.868E+00	1.686E+01
U-234	1964	3	9.777E-01	1.975E+00	1.897E+00
Th-230	1964	3	1.207E-09	6.437E-13	4.952E-09
Ra-226	1964	3	9.224E-13	1.701E-13	1.086E-09
Pb-210	1964	3	0.000E+00	1.196E-15	6.937E-12
Tc-99A	1964	3	2.476E-07	0.000E+00	5.651E-03
I-129A	1964	3	1.241E-07	0.000E+00	9.375E-06
Cl-36A	1964	3	2.759E-14	0.000E+00	6.298E-10
Tc-99B	1964	3	0.000E+00	0.000E+00	0.000E+00
I-129B	1964	3	0.000E+00	0.000E+00	0.000E+00
Cl-36B	1964	3	0.000E+00	0.000E+00	0.000E+00
Tc-99F	1964	3	6.673E-05	0.000E+00	5.949E-05
I-129F	1964	3	0.000E+00	0.000E+00	0.000E+00
Cl-36F	1964	3	0.000E+00	0.000E+00	0.000E+00
Tc-99R	1964	3	0.000E+00	0.000E+00	5.656E-08
I-129R	1964	3	0.000E+00	0.000E+00	2.231E-10
Cl-36R	1964	3	0.000E+00	0.000E+00	0.000E+00
Tc-99V	1964	3	0.000E+00	0.000E+00	0.000E+00

Table B-8. (continued).

P5	Inventory		Consecutive Year of Burial		
Nuclide	Year 1	Years	1	2	3
I-129V	1964	3	0.000E+00	0.000E+00	0.000E+00
Cl-36V	1964	3	0.000E+00	0.000E+00	0.000E+00
Tc-99W	1964	3	0.000E+00	2.752E-07	1.908E-03
I-129W	1964	3	0.000E+00	8.838E-10	3.168E-06
Cl-36W	1964	3	0.000E+00	1.254E-18	3.757E-08
C-14A					
C-14B					
C-14F					
C-14R					
C-14W					
Nb-94	1964	3	1.321E-06	0.000E+00	3.015E-02
Sr-90	1964	3	4.123E-01	0.000E+00	3.783E+01
N-14	1964	1	0.000E+00		
Cr-52	1964	1	0.000E+00		
CT-154	1964	3	0.000E+00	0.000E+00	3.448E+06
MC-85	1964	3	4.159E+04	5.613E+05	1.007E+06
PCE-166	1964	3	0.000E+00	0.000E+00	5.372E+05
DIO-88	1964	3	9.237E+02	7.156E+03	2.189E+04

Units:
- Ci for radionuclides
- gm for VOCs and inorganics (non-radionuclides)

Suffixes:
- A = activated metal
- B = beryllium blocks
- c = colloidal
- F = fuel-like materials
- R = resins
- V = Vycor
- W = surface wash

Table B-9. Inventory allocated to T42-58 by year.

T42-58	Inventory		Consecutive Year of Burial															
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Am-241	1966	16	2.962E-01	2.967E+00	1.095E+02	1.148E+00	5.879E-01	3.012E-01	4.928E-01	1.904E-01	2.176E-01	1.539E-01	3.250E-01	1.573E+00	3.212E-03	4.343E-04	0.000E+00	6.437E-07
Np-237	1966	16	1.873E-03	3.095E-03	8.361E-03	2.657E-03	9.449E-04	9.356E-04	4.225E-03	4.686E-04	3.697E-04	4.976E-04	3.679E-05	9.368E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-233	1966	16	2.899E-06	8.143E-03	6.059E-01	5.556E-07	6.077E-03	2.075E-05	2.357E-02	2.440E-03	5.851E-04	1.231E-08	6.190E-05	9.075E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-229	1966	16	7.739E-10	5.952E-10	5.127E-10	6.488E-10	5.651E-08	2.621E-11	1.416E-10	2.051E-10	2.607E-10	6.314E-13	3.977E-08	3.804E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Am-243	1966	16	1.280E-03	1.039E-03	2.947E-04	1.391E-03	1.387E-02	4.643E-05	1.680E-04	1.051E-03	1.075E-03	2.156E-07	4.734E-03	3.480E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239c	1966	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	1966	16	1.403E+01	7.564E+01	1.841E+02	4.825E+01	1.524E+01	1.871E+01	2.158E+01	4.195E+00	4.231E+00	9.934E+00	7.527E-01	9.826E-02	1.331E-03	1.800E-04	0.000E+00	5.283E-08
U-235	1966	16	7.120E-03	1.644E-02	2.517E-02	2.243E-02	2.966E-03	5.460E-03	1.343E-02	1.822E-03	8.760E-04	1.504E-03	1.082E-04	3.309E-04	2.536E-08	3.428E-09	0.000E+00	3.514E-13
Pa-231	1966	16	6.220E-08	6.227E-08	4.886E-08	2.482E-07	4.912E-08	5.349E-09	2.141E-08	2.876E-08	3.662E-08	8.752E-11	4.235E-08	5.407E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ac-227	1966	16	6.220E-08	6.227E-08	4.886E-08	2.482E-07	4.912E-08	5.349E-09	2.141E-08	2.876E-08	3.662E-08	8.752E-11	4.235E-08	5.407E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-240c	1966	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-240	1966	16	2.669E-01	1.616E+00	3.890E+01	8.169E-01	2.725E-01	2.902E-01	3.838E-01	8.731E-02	8.570E-02	1.522E-01	4.650E-02	1.426E-01	8.242E-04	1.114E-04	0.000E+00	3.294E-08
U-236	1966	16	6.633E-03	1.457E-02	3.608E-02	1.297E-02	3.938E-03	4.795E-03	1.502E-02	1.573E-03	1.275E-03	2.379E-03	1.722E-04	4.578E-06	8.242E-08	1.114E-08	0.000E+00	2.057E-12
Th-232	1966	16	1.500E-01	1.502E-01	1.608E-03	1.501E-01	1.500E-01	4.500E-01	3.359E-05	6.485E-06	2.593E-05	1.557E-05	1.166E-06	2.665E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-228	1966	16	2.517E-11	1.954E-11	5.793E-12	2.768E-11	1.528E-08	9.236E-13	2.614E-12	8.643E-10	2.163E-11	9.287E-16	1.705E-08	8.414E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-238	1966	16	4.135E+00	3.504E+00	1.644E+01	3.660E+00	1.553E+00	5.500E-01	6.628E+00	1.502E+00	1.903E+00	2.763E-01	1.036E-01	1.010E+00	5.643E-04	7.628E-05	0.000E+00	2.286E-07
U-238	1966	16	6.717E-03	6.706E-02	1.468E-01	2.839E-01	2.816E-01	1.645E+00	6.241E-02	1.039E-02	2.083E-03	2.879E-04	2.634E-05	7.615E-04	4.090E-08	5.060E-09	0.000E+00	2.018E-11
U-234	1966	16	1.827E-01	4.199E-01	6.552E-01	5.779E-01	2.364E-01	7.553E-01	3.150E-01	4.632E-02	2.087E-02	3.691E-02	2.665E-03	9.040E-05	3.818E-08	4.723E-09	0.000E+00	2.738E-10
Th-230	1966	16	4.438E-06	5.790E-06	2.841E-06	2.333E-05	5.197E-07	9.190E-07	2.010E-06	1.174E-06	4.511E-07	2.085E-08	2.394E-09	2.016E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	1966	16	1.529E-04	8.434E-04	1.112E-03	3.812E-02	2.399E-03	2.505E-04	1.650E-04	9.038E-08	1.226E-07	6.452E-09	4.776E-10	1.132E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pb-210	1966	16	1.287E-09	1.099E-09	3.651E-10	4.335E-09	9.032E-10	6.379E-11	1.393E-10	6.392E-10	8.542E-10	4.867E-13	1.742E-11	3.141E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99A	1966	16	7.310E-02	1.457E-02	1.232E-02	5.000E-02	6.188E-03	2.905E-04	2.366E-04	5.305E-02	2.945E-05	2.975E-05	5.479E-04	1.017E-03	1.648E-04	2.228E-05	0.000E+00	2.163E-09
I-129A	1966	16	3.419E-06	2.523E-05	3.092E-05	8.413E-05	6.313E-06	1.290E-07	3.898E-07	9.034E-08	5.550E-08	5.607E-08	8.338E-07	1.630E-06	3.107E-07	4.200E-08	0.000E+00	4.076E-12
Cl-36A	1966	16	4.589E-03	3.661E-02	7.198E-03	3.541E-02	8.077E-03	1.528E-03	5.066E-04	6.331E-04	2.328E-04	2.327E-04	3.454E-03	6.751E-03	1.287E-03	1.740E-04	0.000E+00	1.689E-08
Tc-99B	1966	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.471E-03	0.000E+00	0.000E+00	3.896E-05	0.000E+00	0.000E+00	9.740E-04	5.024E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129B	1966	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.500E-05	0.000E+00	0.000E+00	2.860E-07	0.000E+00	0.000E+00	7.150E-06	3.942E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36B	1966	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.291E-01	0.000E+00	0.000E+00	2.524E-03	0.000E+00	0.000E+00	6.310E-02	3.466E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99F	1966	16	8.007E-03	9.160E-02	1.613E+00	1.186E-01	6.660E-02	1.013E-04	1.560E-01	1.180E-06	1.564E-02	7.326E-02	0.000E+00	2.716E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129F	1966	16	1.206E-05	1.942E-04	4.151E-03	2.467E-04	1.376E-04	7.945E-09	3.230E-04	1.939E-09	3.228E-05	1.509E-04	0.000E+00	4.464E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36F	1966	16	1.176E-03	2.350E-06	5.490E-06	3.960E-06	2.225E-06	1.281E-10	5.270E-06	3.709E-14	5.270E-07	2.474E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99R	1966	16	8.135E-02	1.271E-01	1.067E-01	1.537E-01	1.975E-01	1.302E-01	1.299E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129R	1966	16	2.023E-03	2.734E-03	2.653E-03	3.822E-03	4.906E-03	3.237E-03	4.525E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36R	1966	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99V	1966	16	2.700E+00	2.100E+00	1.600E+00	2.600E-01	7.300E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Table B-9. (continued).

T42-58	Inventory		Consecutive Year of Burial															
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
I-129V	1966	16	7.300E-03	5.800E-03	4.200E-03	7.100E-04	2.000E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36V	1966	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99W	1966	16	2.659E-01	4.417E-01	6.101E-01	3.384E-01	7.724E-02	1.945E-01	3.473E-01	9.621E-02	1.018E-01	1.400E-03	5.361E-03	3.563E-04	0.000E+00	0.000E+00	0.000E+00	8.797E-07
I-129W	1966	16	4.904E-04	9.294E-04	1.329E-03	6.526E-04	1.463E-04	3.093E-04	4.892E-04	1.698E-04	1.677E-04	2.297E-06	1.112E-05	1.654E-08	0.000E+00	0.000E+00	0.000E+00	3.536E-09
Cl-36W	1966	16	3.228E-06	1.140E-05	2.108E-05	7.990E-06	2.125E-04	9.238E-06	2.131E-05	4.359E-04	2.689E-03	1.081E-07	1.810E-07	4.200E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14A																		
C-14B																		
C-14F																		
C-14R																		
C-14W																		
Nb-94	1966	16	2.518E+00	1.291E+00	1.118E+00	3.754E+00	4.742E-01	4.364E-01	2.034E-02	1.200E-01	7.420E-03	7.766E-03	1.146E-01	2.220E-01	4.121E-02	5.571E-03	0.000E+00	5.408E-07
Sr-90	1966	16	4.458E+01	5.543E+02	7.305E+03	1.015E+03	4.139E+02	6.276E+00	9.291E+02	3.622E-01	9.244E+01	4.327E+02	8.291E-02	2.535E-01	3.043E-02	4.114E-03	0.000E+00	3.993E-07
N-14	1966	1	0.000E+00															
Cr-52	1966	1	0.000E+00															
CT-154	1966	9	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00							
MC-85	1966	9	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00							
PCE-166	1966	9	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00							
DIO-88	1966	9	5.622E+01	5.524E+01	3.768E+01	3.472E+01	1.332E+02	0.000E+00	5.679E+02	1.290E+03	4.928E+02							

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-10. Inventory allocated to P6 by year.

P6	Inventory		Consecutive Year of Burial	
Nuclide	Year 1	Years	1	2
Am-241	1967	2	3.552E+03	8.376E+03
Np-237	1967	2	9.602E-07	1.858E-08
U-233	1967	2	6.706E-10	8.150E-02
Th-229	1967	2	2.634E-13	3.583E-14
Am-243	1967	2	1.202E-06	1.273E-07
Pu-239c	1967	2	3.346E+01	9.357E+01
Pu-239	1967	2	8.708E+02	2.435E+03
U-235	1967	2	1.467E-01	7.238E-02
Pa-231	1967	2	3.675E-11	4.357E-12
Ac-227	1967	2	3.675E-11	4.357E-12
Pu-240c	1967	2	7.613E+00	2.150E+01
Pu-240	1967	2	1.981E+02	5.595E+02
U-236	1967	2	3.138E-02	3.068E-02
Th-232	1967	2	9.727E-16	1.187E-16
Ra-228	1967	2	1.820E-14	2.536E-15
Pu-238	1967	2	2.603E+01	7.668E+01
U-238	1967	2	5.607E+00	7.218E+00
U-234	1967	2	2.237E+00	2.068E+00
Th-230	1967	2	1.450E-09	6.506E-11
Ra-226	1967	2	1.209E-10	1.676E-11
Pb-210	1967	2	8.442E-13	1.178E-13
Tc-99A	1967	2	7.715E-05	1.683E-07
I-129A	1967	2	1.393E-07	2.767E-10
Cl-36A	1967	2	2.536E-12	0.000E+00
Tc-99B	1967	2	0.000E+00	0.000E+00
I-129B	1967	2	0.000E+00	0.000E+00
Cl-36B	1967	2	0.000E+00	0.000E+00
Tc-99F	1967	2	6.256E-07	0.000E+00
I-129F	1967	2	0.000E+00	0.000E+00
Cl-36F	1967	2	0.000E+00	0.000E+00
Tc-99R	1967	2	0.000E+00	0.000E+00
I-129R	1967	2	0.000E+00	0.000E+00
Cl-36R	1967	2	0.000E+00	0.000E+00
Tc-99V	1967	2	0.000E+00	0.000E+00

Table B-10. (continued).

P6	Inventory		Consecutive Year of Burial	
Nuclide	Year 1	Years	1	2
I-129V	1967	2	0.000E+00	0.000E+00
Cl-36V	1967	2	0.000E+00	0.000E+00
Tc-99W	1967	2	6.683E-05	9.219E-06
I-129W	1967	2	1.115E-07	1.494E-08
Cl-36W	1967	2	2.508E-15	0.000E+00
C-14A				
C-14B				
C-14F				
C-14R				
C-14W				
Nb-94	1967	2	1.214E-04	0.000E+00
Sr-90	1967	2	4.895E-01	1.119E-03
N-14	1967	2	9.261E+06	4.231E+07
Cr-52	1967	2	2.661E+04	1.226E+05
CT-154	1967	2	9.144E+07	1.448E+08
MC-85	1967	2	2.658E+05	8.882E+05
PCE-166	1967	2	1.124E+07	1.783E+07
DIO-88	1967	2	2.002E+05	3.198E+05

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-11. Inventory allocated to P8 by year.

P8	Inventory		Consecutive Year of Burial				
Nuclide	Year 1	Years	1	2	3	4	5
Am-241	1966	5	8.276E-04	4.686E-02	4.954E-04	2.934E-03	1.334E-12
Np-237	1966	5	5.648E-07	1.043E-05	3.386E-07	4.557E-06	1.204E-17
U-233	1966	5	9.400E-11	2.628E-09	5.544E-10	4.604E-10	1.090E-15
Th-229	1966	5	1.001E-12	6.263E-13	7.754E-13	2.385E-12	0.000E+00
Am-243	1966	5	3.674E-06	7.159E-06	2.748E-06	8.452E-06	0.000E+00
Pu-239c	1966	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	1966	5	4.970E-04	3.591E-02	6.781E-05	4.777E-02	1.608E-13
U-235	1966	5	2.092E-07	1.591E-05	2.429E-08	8.054E-06	8.478E-20
Pa-231	1966	5	1.241E-10	1.707E-10	9.421E-11	2.882E-10	0.000E+00
Ac-227	1966	5	1.241E-10	1.707E-10	9.421E-11	2.882E-10	0.000E+00
Pu-240c	1966	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-240	1966	5	2.718E-04	1.883E-02	5.208E-05	1.158E-03	1.006E-13
U-236	1966	5	3.979E-07	3.059E-05	6.246E-08	1.453E-05	4.437E-18
Th-232	1966	5	3.294E-15	1.827E-10	2.552E-15	7.375E-08	0.000E+00
Ra-228	1966	5	7.095E-14	4.321E-14	5.495E-14	1.674E-13	0.000E+00
Pu-238	1966	5	1.101E-02	1.768E-02	4.131E-03	1.604E-02	1.006E-12
U-238	1966	5	1.733E-06	6.063E-05	1.265E-09	2.229E-06	1.064E-14
U-234	1966	5	2.427E-05	5.427E-04	3.437E-06	1.904E-04	6.494E-13
Th-230	1966	5	0.000E+00	1.832E-08	1.374E-09	4.431E-09	0.000E+00
Ra-226	1966	5	4.690E-10	2.984E-10	3.631E-10	1.136E-09	0.000E+00
Pb-210	1966	5	0.000E+00	2.004E-12	2.551E-12	7.767E-12	0.000E+00
Tc-99A	1966	5	0.000E+00	1.242E-06	3.601E-07	1.238E-05	0.000E+00
I-129A	1966	5	4.480E-08	1.298E-07	0.000E+00	2.030E-08	0.000E+00
Cl-36A	1966	5	0.000E+00	2.346E-08	0.000E+00	1.489E-12	0.000E+00
Tc-99B	1966	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129B	1966	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36B	1966	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99F	1966	5	1.360E-05	6.897E-05	3.620E-08	0.000E+00	0.000E+00
I-129F	1966	5	0.000E+00	0.000E+00	0.000E+00	7.488E-11	0.000E+00
Cl-36F	1966	5	0.000E+00	0.000E+00	0.000E+00	1.225E-12	0.000E+00
Tc-99R	1966	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129R	1966	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36R	1966	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99V	1966	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Table B-11. (continued).

P8	Inventory		Consecutive Year of Burial				
Nuclide	Year 1	Years	1	2	3	4	5
I-129V	1966	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36V	1966	5	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99W	1966	5	5.068E-04	1.097E-03	1.985E-04	1.030E-03	4.001E-12
I-129W	1966	5	4.054E-07	1.984E-06	3.218E-07	1.818E-06	1.608E-14
Cl-36W	1966	5	0.000E+00	4.005E-11	2.006E-14	1.173E-08	0.000E+00
C-14A							
C-14B							
C-14F							
C-14R							
C-14W							
Nb-94	1966	4	8.996E-11	7.360E-06	0.000E+00	7.126E-05	
Sr-90	1966	4	1.488E-01	4.327E-01	0.000E+00	8.229E-02	
N-14	1966	1	0.000E+00				
Cr-52	1966	1	0.000E+00				
CT-154	1967	1	0.000E+00				
MC-85	1967	1	0.000E+00				
PCE-166	1967	1	0.000E+00				
DIO-88	1967	1	1.578E+02				

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-12. Inventory allocated to P7&9 by year.

P7&9	Inventory		Consecutive Year of Burial			
Nuclide	Year 1	Years	1	2	3	4
Am-241	1966	4	9.052E-06	6.037E-06	1.017E+04	7.971E-04
Np-237	1966	4	3.970E-11	1.825E-07	1.872E-07	1.309E-06
U-233	1966	4	3.580E-09	1.371E-11	1.652E-10	5.311E-10
Th-229	1966	4	0.000E+00	4.093E-15	8.361E-14	8.126E-13
Am-243	1966	4	0.000E+00	2.690E-09	2.874E-07	2.874E-06
Pu-239c	1966	4	0.000E+00	0.000E+00	1.096E+02	0.000E+00
Pu-239	1966	4	5.294E-07	1.894E-06	2.853E+03	1.801E-02
U-235	1966	4	2.779E-13	2.799E-03	3.462E-02	2.755E-06
Pa-231	1966	4	0.000E+00	0.000E+00	1.001E-11	9.851E-11
Ac-227	1966	4	0.000E+00	0.000E+00	1.001E-11	9.851E-11
Pu-240c	1966	4	0.000E+00	0.000E+00	2.512E+01	0.000E+00
Pu-240	1966	4	3.321E-07	1.537E-06	6.537E+02	3.302E-04
U-236	1966	4	1.459E-11	4.708E-07	1.903E-02	4.503E-06
Th-232	1966	4	0.000E+00	7.622E-17	3.298E-16	2.813E-08
Ra-228	1966	4	0.000E+00	1.162E-17	5.692E-15	5.747E-14
Pu-238	1966	4	3.321E-06	3.467E-04	8.717E+01	4.929E-03
U-238	1966	4	1.770E-11	6.297E-02	1.391E+00	5.151E-07
U-234	1966	4	1.079E-09	6.197E-02	1.885E+00	6.925E-05
Th-230	1966	4	0.000E+00	3.344E-13	1.459E-10	1.437E-09
Ra-226	1966	4	0.000E+00	2.255E-16	3.754E-11	3.913E-10
Pb-210	1966	4	0.000E+00	0.000E+00	2.638E-13	2.668E-12
Tc-99A	1966	4	0.000E+00	1.351E-05	1.112E-05	0.000E+00
I-129A	1966	4	0.000E+00	2.215E-08	1.823E-08	0.000E+00
Cl-36A	1966	4	0.000E+00	1.506E-12	1.236E-12	0.000E+00
Tc-99B	1966	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129B	1966	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36B	1966	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99F	1966	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129F	1966	4	0.000E+00	0.000E+00	3.600E-10	0.000E+00
Cl-36F	1966	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99R	1966	4	1.176E-05	0.000E+00	0.000E+00	0.000E+00
I-129R	1966	4	4.642E-08	0.000E+00	0.000E+00	0.000E+00
Cl-36R	1966	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99V	1966	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Table B-12. (continued).

P7&9	Inventory		Consecutive Year of Burial			
Nuclide	Year 1	Years	1	2	3	4
I-129V	1966	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36V	1966	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99W	1966	4	1.510E-06	0.000E+00	2.106E-05	3.460E-04
I-129W	1966	4	6.070E-09	0.000E+00	3.507E-08	6.200E-07
Cl-36W	1966	4	0.000E+00	0.000E+00	0.000E+00	4.472E-09
C-14A						
C-14B						
C-14F						
C-14R						
C-14W						
Nb-94	1967	2	7.209E-05	5.918E-05		
Sr-90	1967	2	8.959E-02	7.550E-02		
N-14	1968	1	6.892E+06			
Cr-52	1968	1	1.993E+04			
CT-154	1968	2	1.027E+08	0.000E+00		
MC-85	1968	2	9.791E+05	0.000E+00		
PCE-166	1968	2	1.262E+07	0.000E+00		
DIO-88	1968	2	2.279E+05	3.551E+00		

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-13. Inventory allocated to P10-12 by year.

P10-12	Inventory		Consecutive Year of Burial				
Nuclide	Year 1	Years	1	2	3	4	5
Am-241	1968	5	1.289E+03	3.257E+04	5.857E+03	2.924E-01	4.461E+01
Np-237	1968	5	1.657E-07	3.097E-05	5.316E-05	9.227E-04	0.000E+00
U-233	1968	5	7.340E-10	1.648E-08	6.804E-09	5.953E-10	0.000E+00
Th-229	1968	5	7.367E-14	5.789E-11	5.450E-12	5.467E-14	0.000E+00
Am-243	1968	5	3.323E-07	2.052E-04	1.942E-05	1.826E-07	0.000E+00
Pu-239c	1968	5	3.527E+01	3.609E+02	1.850E+02	0.000E+00	3.402E+00
Pu-239	1968	5	9.180E+02	9.394E+03	4.816E+03	1.902E+01	8.854E+01
U-235	1968	5	7.263E-02	1.374E-01	9.102E-02	4.194E-03	3.010E-02
Pa-231	1968	5	1.033E-11	7.032E-09	6.630E-10	6.165E-12	0.000E+00
Ac-227	1968	5	1.033E-11	7.032E-09	6.630E-10	6.165E-12	0.000E+00
Pu-240c	1968	5	7.983E+00	8.211E+01	4.164E+01	0.000E+00	0.000E+00
Pu-240	1968	5	2.078E+02	2.137E+03	1.084E+03	2.913E-01	0.000E+00
U-236	1968	5	3.450E-02	4.674E-02	2.360E-02	2.002E-02	1.853E-02
Th-232	1968	5	2.424E-16	9.088E-08	1.606E-06	4.184E-05	0.000E+00
Ra-228	1968	5	5.222E-15	4.099E-12	3.851E-13	3.604E-15	0.000E+00
Pu-238	1968	5	1.716E+01	2.697E+02	1.220E+02	4.770E-01	2.824E+00
U-238	1968	5	6.748E+00	1.151E+01	2.820E+00	1.329E+00	1.583E+00
U-234	1968	5	2.894E+00	2.667E+00	8.040E-01	6.929E-02	4.327E-01
Th-230	1968	5	3.765E-10	1.033E-07	1.015E-08	9.114E-11	0.000E+00
Ra-226	1968	5	3.469E-11	2.712E-08	3.209E-09	1.236E-08	0.000E+00
Pb-210	1968	5	2.424E-13	1.903E-10	1.788E-11	1.668E-13	0.000E+00
Tc-99A	1968	4	1.366E-05	1.188E-03	6.067E-05	1.161E-05	
I-129A	1968	4	2.520E-08	2.962E-07	1.293E-07	1.903E-08	
Cl-36A	1968	4	2.508E-12	7.367E-08	7.741E-08	4.821E-11	
Tc-99B	1968	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
I-129B	1968	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Cl-36B	1968	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Tc-99F	1968	4	0.000E+00	4.900E-07	3.112E-03	1.390E-01	
I-129F	1968	4	0.000E+00	1.013E-09	6.441E-06	2.860E-04	
Cl-36F	1968	4	0.000E+00	1.658E-11	1.050E-07	4.680E-06	
Tc-99R	1968	4	0.000E+00	2.989E-05	2.302E-05	4.751E-07	
I-129R	1968	4	0.000E+00	1.179E-07	9.084E-08	1.874E-09	
Cl-36R	1968	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Tc-99V	1968	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	

Table B-13. (continued).

P10-12	Inventory		Consecutive Year of Burial				
Nuclide	Year 1	Years	1	2	3	4	5
I-129V	1968	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Cl-36V	1968	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
Tc-99W	1968	4	2.122E-05	1.516E-02	5.851E-03	1.609E-03	
I-129W	1968	4	4.019E-08	2.450E-05	1.143E-05	3.321E-06	
Cl-36W	1968	4	0.000E+00	1.443E-08	1.500E-07	5.381E-08	
C-14A							
C-14B							
C-14F							
C-14R							
C-14W							
Nb-94	1968	4	1.201E-04	1.785E+00	4.289E-04	6.869E-04	
Sr-90	1968	4	8.371E-02	1.229E+00	1.894E+01	8.201E+02	
N-14	1968	3	4.293E+07	6.177E+07	3.469E+06		
Cr-52	1968	3	1.241E+05	1.786E+05	1.291E+04		
CT-154	1968	3	6.307E+07	3.232E+07	3.549E+05		
MC-85	1968	3	1.534E+05	2.954E+06	5.994E+05		
PCE-166	1968	3	8.348E+06	4.747E+06	5.213E+04		
DIO-88	1968	3	1.510E+05	1.170E+05	3.076E+04		

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-14. Inventory allocated to P13 by year.

P13	Inventory		Consecutive Year of Burial			
Nuclide	Year 1	Years	1	2	3	4
Am-241	1971	4	4.634E-02	1.036E-01	2.481E-01	3.013E-01
Np-237	1971	4	9.087E-05	2.150E-05	1.206E-03	1.476E-04
U-233	1971	4	6.581E-09	1.123E-08	2.209E-07	1.458E-07
Th-229	1971	4	3.562E-13	7.502E-13	2.140E-12	2.761E-10
Am-243	1971	4	3.278E-06	1.380E-05	7.665E-06	9.911E-04
Pu-239c	1971	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	1971	4	4.592E+00	8.551E-02	1.954E+01	1.877E-01
U-235	1971	4	3.058E-03	3.506E-05	1.328E-02	1.390E-04
Pa-231	1971	4	8.257E-11	3.080E-10	2.614E-10	3.356E-08
Ac-227	1971	4	8.257E-11	3.080E-10	2.614E-10	3.356E-08
Pu-240c	1971	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-240	1971	4	7.744E-02	4.181E-02	3.003E-01	7.005E-02
U-236	1971	4	1.084E-03	6.504E-05	5.031E-03	1.144E-04
Th-232	1971	4	7.146E-06	9.648E-09	3.063E-05	1.059E-07
Ra-228	1971	4	2.559E-14	5.454E-14	1.515E-13	1.986E-11
Pu-238	1971	4	1.218E-01	3.320E-02	2.411E+00	1.495E+00
U-238	1971	4	5.212E-04	1.347E-04	1.309E-02	1.652E-04
U-234	1971	4	6.864E-02	1.223E-03	7.890E-02	2.927E-03
Th-230	1971	4	7.530E-09	2.353E-09	4.094E-09	5.274E-07
Ra-226	1971	4	1.334E-09	3.837E-10	1.050E-08	1.289E-07
Pb-210	1971	4	1.166E-12	2.464E-12	7.031E-12	9.145E-10
Tc-99A	1971	4	5.863E-06	5.120E-07	5.035E-06	2.912E-05
I-129A	1971	4	9.612E-09	8.393E-10	8.254E-09	4.774E-08
Cl-36A	1971	4	4.692E-09	5.706E-14	2.308E-11	3.246E-12
Tc-99B	1971	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129B	1971	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36B	1971	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99F	1971	4	0.000E+00	0.000E+00	4.990E-02	5.781E-05
I-129F	1971	4	0.000E+00	0.000E+00	1.030E-04	1.193E-07
Cl-36F	1971	4	0.000E+00	0.000E+00	1.680E-06	1.948E-09
Tc-99R	1971	4	1.015E-03	0.000E+00	6.754E-02	4.972E-02
I-129R	1971	4	2.482E-05	0.000E+00	1.679E-03	1.237E-03
Cl-36R	1971	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99V	1971	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Table B-14. (continued).

P13	Inventory		Consecutive Year of Burial			
Nuclide	Year 1	Years	1	2	3	4
I-129V	1971	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36V	1971	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99W	1971	4	3.419E-02	2.385E-03	1.093E-01	7.314E-02
I-129W	1971	4	7.053E-05	4.430E-06	2.206E-04	1.196E-04
Cl-36W	1971	4	1.139E-06	1.536E-09	3.177E-06	1.489E-08
C-14A						
C-14B						
C-14F						
C-14R						
C-14W						
Nb-94	1971	4	3.142E-05	2.731E-06	2.518E-04	1.556E-04
Sr-90	1971	4	3.887E-02	3.394E-03	2.950E+02	5.344E-01
N-14	1971	1	0.000E+00			
Cr-52	1971	1	0.000E+00			
CT-154	1971	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
MC-85	1971	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PCE-166	1971	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
DIO-88	1971	4	0.000E+00	4.472E+01	5.366E+01	4.472E+01

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-15. Inventory allocated to Pad A by year.

Pad A	Inventory		Consecutive Year of Burial						
Nuclide	Year 1	Years	1	2	3	4	5	6	7
Am-241	1972	5	5.344E+01	7.508E-06	2.766E-06	8.851E-05	1.991E-05		
Np-237	1972	5	0.000E+00	2.369E-08	8.731E-09	2.797E-07	6.138E-08		
U-233	1972	5	0.000E+00	4.470E-20	5.592E-15	0.000E+00	2.990E-14		
Th-229	1972	5	0.000E+00	1.340E-23	4.736E-22	0.000E+00	0.000E+00		
Am-243	1972	7	0.000E+00	8.808E-18	3.113E-16	0.000E+00	6.942E-11	0.000E+00	0.000E+00
Pu-239c	1972	7	1.164E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	1972	7	3.030E+01	4.883E-04	1.797E-04	5.759E-03	1.261E-03	0.000E+00	0.000E+00
U-235	1972	7	2.073E-02	4.665E-02	4.643E-02	4.637E-02	4.637E-02	4.637E-02	4.637E-02
Pa-231	1972	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.346E-15	0.000E+00	0.000E+00
Ac-227	1972	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.346E-15	0.000E+00	0.000E+00
Pu-240c	1972	7	1.859E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-240	1972	7	4.840E+00	2.161E-01	2.755E-06	8.805E-05	1.955E-05	0.000E+00	0.000E+00
U-236	1972	7	1.422E-02	1.148E-07	4.230E-08	1.351E-06	2.962E-07	0.000E+00	0.000E+00
Th-232	1972	7	0.000E+00	7.657E-10	2.810E-05	9.027E-09	1.977E-09	0.000E+00	0.000E+00
Ra-228	1972	7	0.000E+00	3.804E-26	1.344E-24	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-238	1972	7	9.665E-01	1.221E-05	4.518E-06	1.440E-04	3.185E-05	0.000E+00	0.000E+00
U-238	1972	7	1.292E+00	5.243E+00	4.984E+00	3.430E+00	3.535E+00	2.422E+00	1.161E+00
U-234	1972	7	2.064E-01	1.064E+00	8.759E-01	7.430E-01	6.273E-01	4.452E-01	2.507E-01
Th-230	1972	7	0.000E+00	1.095E-21	3.869E-20	1.612E-03	1.900E-04	4.797E-03	1.129E-02
Ra-226	1972	7	0.000E+00	3.164E-13	1.170E-13	1.550E-03	1.826E-04	4.612E-03	1.086E-02
Pb-210	1972	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99A	1973	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
I-129A	1973	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			

Table B-15. (continued).

Pad A	Inventory		Consecutive Year of Burial						
Nuclide	Year 1	Years	1	2	3	4	5	6	7
Cl-36A	1973	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
Tc-99B	1973	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
I-129B	1973	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
Cl-36B	1973	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
Tc-99F	1973	4	3.460E-06	1.294E-06	4.248E-05	9.308E-06			
I-129F	1973	4	7.143E-09	2.671E-09	8.750E-08	1.913E-08			
Cl-36F	1973	4	1.165E-10	4.361E-11	1.434E-09	3.135E-10			
Tc-99R	1973	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
I-129R	1973	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
Cl-36R	1973	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
Tc-99V	1973	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
I-129V	1973	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
Cl-36V	1973	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00			
Tc-99W	1973	4	1.441E-07	3.672E-08	0.000E+00	1.326E-08			
I-129W	1973	4	2.977E-10	7.564E-11	0.000E+00	2.457E-11			
Cl-36W	1973	4	4.861E-12	1.235E-12	0.000E+00	0.000E+00			
C-14A									
C-14B									
C-14F									
C-14R									
C-14W									
Nb-94	1973	4	1.560E-08	5.829E-09	1.916E-07	4.196E-08			
Sr-90	1973	4	2.046E-02	7.642E-03	2.509E-01	5.498E-02			
N-14	1972	7	1.419E+07	3.057E+07	4.829E+07	4.573E+07	4.977E+07	3.718E+07	9.755E+06

Table B-15. (continued).

Pad A	Inventory		Consecutive Year of Burial						
Nuclide	Year 1	Years	1	2	3	4	5	6	7
Cr-52	1972	7	1.097E+05	2.317E+05	3.732E+05	3.534E+05	3.846E+05	2.874E+05	7.539E+04
CT-154	1972	1	0.000E+00						
MC-85	1972	1	0.000E+00						
PCE-166	1972	1	0.000E+00						
DIO-88	1972	1	0.000E+00						

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-16. Inventory allocated to P14-16 by year.

P14-16	Inventory		Consecutive Year of Burial										
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8	9	10	11
Am-241	1974	11	8.892E-01	5.124E-01	2.910E-01	3.009E-01	4.282E-01	9.170E-02	5.371E-02	4.938E-02	9.716E-03	5.817E-02	4.706E-04
Np-237	1974	11	6.182E-04	3.952E-04	5.620E-04	4.252E-04	4.372E-04	1.181E-04	5.255E-04	4.409E-03	2.157E-05	1.041E-03	5.549E-07
U-233	1974	11	8.548E-08	6.596E-08	2.422E-08	2.430E-06	1.141E-06	5.515E-07	7.005E-06	7.557E-09	2.507E-09	6.695E-09	2.037E-09
Th-229	1974	11	1.296E-09	7.536E-10	2.334E-10	1.732E-09	1.172E-09	4.065E-10	3.759E-09	7.429E-11	4.680E-12	5.998E-13	5.901E-13
Am-243	1974	11	4.590E-03	2.642E-03	8.598E-04	1.571E-03	2.175E-03	4.485E-04	2.132E-04	2.650E-04	1.688E-05	1.236E-06	2.085E-06
Pu-239c	1974	11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	1974	11	1.111E+00	1.259E+00	9.292E+00	2.240E+00	2.394E+00	6.840E-01	2.732E+00	9.675E-01	3.947E-01	3.587E+00	5.956E-03
U-235	1974	11	2.370E-04	5.003E-03	4.128E-03	1.442E-02	6.714E-03	4.742E-03	2.941E-01	2.680E-01	7.879E-04	1.148E-03	3.152E-05
Pa-231	1974	11	1.558E-07	9.410E-08	2.934E-08	1.125E-07	1.004E-07	2.839E-08	1.773E-07	9.086E-09	5.776E-10	2.957E-11	7.271E-11
Ac-227	1974	11	1.558E-07	9.410E-08	2.934E-08	1.125E-07	1.004E-07	2.839E-08	1.773E-07	9.086E-09	5.776E-10	2.957E-11	7.271E-11
Pu-240c	1974	11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-240	1974	11	1.194E-01	7.130E-02	1.592E-01	6.067E-02	7.840E-02	1.880E-02	2.760E-01	6.875E-03	6.610E-03	5.598E-02	1.350E-04
U-236	1974	11	3.509E-04	3.601E-04	2.232E-03	2.653E-03	1.506E-03	6.300E-04	6.644E-03	3.541E-05	9.389E-05	8.877E-04	1.481E-06
Th-232	1974	11	1.509E-06	1.100E-02	1.453E-05	3.436E-04	1.334E-04	7.361E-07	3.233E-04	1.782E-07	6.154E-07	5.607E-06	9.215E-09
Ra-228	1974	11	9.510E-11	5.277E-11	1.703E-11	3.124E-11	4.337E-11	8.975E-12	4.423E-12	5.300E-12	3.361E-13	1.546E-14	4.123E-14
Pu-238	1974	11	6.873E+00	4.195E+00	1.541E+00	2.404E+00	3.315E+00	6.937E-01	3.924E-01	4.027E-01	3.589E-02	1.252E-01	3.310E-03
U-238	1974	11	8.800E-05	3.667E-04	1.513E-01	3.126E-02	9.316E-02	1.584E-01	1.390E-02	4.975E-01	5.324E-01	5.219E-01	5.485E-04
U-234	1974	11	9.824E-03	3.480E-02	7.813E-02	3.764E-01	1.852E-01	1.236E-01	9.935E-01	7.502E-04	1.742E-02	2.630E-02	7.001E-04
Th-230	1974	11	2.264E-06	1.367E-06	4.083E-07	1.276E-05	6.482E-06	2.932E-06	3.511E-05	1.317E-07	8.532E-09	1.283E-09	1.092E-09
Ra-226	1974	11	6.056E-07	3.521E-07	2.000E-01	2.119E-07	2.920E-07	1.676E-04	5.783E-08	1.035E-06	2.444E-09	2.414E-09	2.757E-10
Pb-210	1974	11	4.321E-09	2.502E-09	7.676E-10	1.836E-09	2.195E-09	5.081E-10	1.395E-09	2.444E-10	1.538E-11	6.664E-13	1.950E-12
Tc-99A	1974	11	1.109E-06	7.508E-02	9.875E-04	7.529E-02	0.000E+00	0.000E+00	3.629E-05	8.412E-11	0.000E+00	1.008E-03	6.008E-15
I-129A	1974	11	1.819E-09	1.402E-09	1.217E-06	8.475E-08	0.000E+00	0.000E+00	0.000E+00	1.585E-13	0.000E+00	1.652E-06	1.132E-17
Cl-36A	1974	11	1.236E-13	5.677E-04	1.918E-07	4.221E-04	0.000E+00	0.000E+00	1.662E-08	6.568E-10	0.000E+00	1.123E-10	4.691E-14
Tc-99B	1974	11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129B	1974	11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36B	1974	11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99F	1974	11	9.271E-09	3.400E-03	5.789E-02	4.726E-05	1.420E-02	2.710E-03	6.199E-06	6.032E-06	1.485E-03	2.590E-02	0.000E+00
I-129F	1974	11	1.913E-11	1.070E-05	1.190E-04	9.911E-08	2.930E-05	5.590E-06	1.275E-08	1.241E-08	3.056E-06	5.340E-05	0.000E+00
Cl-36F	1974	11	3.124E-13	1.148E-07	1.950E-06	1.621E-09	4.780E-07	9.140E-08	2.090E-10	2.030E-10	4.998E-08	8.730E-07	0.000E+00
Tc-99R	1974	11	3.897E-02	1.006E-01	1.002E-01	2.455E-01	1.692E-01	1.288E-01	5.868E-01	8.334E-02	8.400E-02	1.047E-01	6.728E-02
I-129R	1974	11	9.710E-04	2.503E-03	2.491E-03	1.919E-03	2.347E-03	2.272E-03	2.500E-03	2.072E-03	2.089E-03	2.605E-03	1.673E-03
Cl-36R	1974	11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99V	1974	11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Table B-16. (continued).

P14-16	Inventory		Consecutive Year of Burial										
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8	9	10	11
I-129V	1974	11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36V	1974	11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99W	1974	11	3.368E-01	1.945E-01	7.182E-02	1.212E-01	1.557E-01	3.309E-02	1.639E-02	1.986E-02	2.665E-03	9.751E-04	2.020E-04
I-129W	1974	11	5.442E-04	3.144E-04	1.207E-04	1.995E-04	2.491E-04	5.334E-05	2.674E-05	3.220E-05	4.954E-06	1.886E-06	3.622E-07
Cl-36W	1974	11	2.399E-07	1.818E-07	3.284E-04	1.612E-04	8.406E-04	3.575E-07	3.829E-06	7.945E-08	4.791E-08	1.854E-08	2.232E-09
C-14A													
C-14B													
C-14F													
C-14R													
C-14W													
Nb-94	1974	11	5.918E-06	2.326E-01	1.359E-02	1.661E-01	6.400E-05	1.220E-05	1.519E-05	4.817E-08	6.683E-06	5.494E-03	1.502E-12
Sr-90	1974	11	7.409E-03	3.809E+01	3.469E+02	5.919E-01	8.380E+01	1.600E+01	3.666E-02	3.556E-02	8.754E+00	1.597E+02	1.109E-12
N-14	1974	1	0.000E+00										
Cr-52	1974	1	0.000E+00										
CT-154	1974	10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
MC-85	1974	10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
PCE-166	1974	10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
DIO-88	1974	10	7.673E+02	4.343E+03	3.914E+03	1.937E+04	5.208E+03	2.769E+01	2.899E+01	3.562E+01	1.751E+01	1.077E+01	

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-17. Inventory allocated to SVRs by year.

SVRs	Inventory		Consecutive Year of Burial																	
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Am-241	1977	18	7.121E-02	6.387E-01	3.353E-01	2.357E-01	2.358E-01	5.745E-01	5.781E-02	8.237E-02	2.673E-02	2.608E-02	1.991E-01	9.877E-01	1.518E-02	4.043E-01	1.211E-02	1.044E-02	2.004E-01	3.544E-03
Np-237	1977	18	2.255E-04	7.516E-04	2.491E-04	2.058E-04	1.217E-03	1.490E-02	2.015E-04	2.201E-04	7.391E-05	9.376E-05	1.129E-04	3.122E-03	1.930E-06	6.262E-04	5.626E-10	1.460E-05	1.323E-06	0.000E+00
U-233	1977	18	0.000E+00	7.733E-08	3.317E-08	3.505E-08	5.462E-07	1.116E-06	3.139E-09	7.503E-09	5.445E-09	3.878E-09	3.734E-05	0.000E+00	3.180E-09	1.367E-06	5.075E-08	0.000E+00	4.270E-05	0.000E+00
Th-229	1977	18	0.000E+00	9.514E-10	4.970E-10	3.365E-10	2.932E-10	3.340E-10	8.413E-13	2.065E-12	1.728E-12	1.298E-12	5.332E-08	0.000E+00	0.000E+00	1.683E-10	0.000E+00	0.000E+00	5.062E-08	0.000E+00
Am-243	1977	18	0.000E+00	3.357E-03	1.761E-03	1.193E-03	9.727E-04	2.195E-04	5.530E-07	1.357E-06	7.516E-07	4.447E-07	8.185E-03	0.000E+00	0.000E+00	2.668E-06	0.000E+00	0.000E+00	8.703E-03	0.000E+00
Pu-239c	1977	18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	1977	18	4.641E+00	2.155E+00	6.414E-01	1.254E+00	1.525E+00	2.969E-01	3.372E+00	2.657E+00	4.538E-01	1.290E+00	1.791E+00	6.424E+01	4.584E-02	4.019E+00	4.974E-03	3.024E-01	1.461E-02	1.469E-03
U-235	1977	18	6.906E-04	4.978E-04	1.057E-04	1.920E-04	9.262E-04	1.013E-02	5.265E-04	2.353E-03	1.473E-04	2.576E-04	2.822E-04	9.546E-03	6.025E-06	1.276E-02	9.460E-08	4.465E-05	3.998E-08	2.798E-08
Pa-231	1977	18	0.000E+00	1.145E-07	6.013E-08	4.073E-08	3.270E-08	0.000E+00	0.000E+00	0.000E+00	1.820E-10	1.820E-10	4.067E-08	0.000E+00	0.000E+00	4.808E-08	0.000E+00	0.000E+00	5.684E-08	0.000E+00
Ac-227	1977	18	0.000E+00	1.145E-07	6.013E-08	4.073E-08	3.270E-08	0.000E+00	0.000E+00	0.000E+00	1.820E-10	1.820E-10	4.067E-08	0.000E+00	0.000E+00	4.808E-08	0.000E+00	0.000E+00	5.684E-08	0.000E+00
Pu-240c	1977	18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-240	1977	18	7.107E-02	9.791E-02	4.592E-02	4.265E-02	5.020E-02	1.278E-01	5.309E-02	5.099E-02	9.890E-03	2.271E-02	5.299E-02	9.828E-01	4.345E-03	5.702E-01	3.079E-03	6.086E-03	2.650E-02	9.093E-04
U-236	1977	18	1.087E-03	1.174E-03	1.871E-04	3.130E-04	3.019E-03	3.845E-02	8.879E-04	8.585E-04	2.539E-04	3.961E-04	4.837E-04	1.511E-02	9.704E-06	5.733E-03	3.076E-07	7.055E-05	8.438E-07	9.093E-08
Th-232	1977	18	7.268E-06	3.237E-06	9.280E-07	1.922E-06	2.327E-06	2.220E-07	5.280E-06	4.130E-06	6.830E-07	1.993E-06	1.500E-01	1.011E-04	6.230E-08	0.000E+00	0.000E+00	4.700E-07	1.912E-08	0.000E+00
Ra-228	1977	18	0.000E+00	6.660E-11	3.497E-11	2.369E-11	1.908E-11	9.480E-13	2.388E-15	5.863E-15	3.202E-15	1.877E-15	1.633E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.554E-08	0.000E+00
Pu-238	1977	18	1.168E-01	5.502E+00	2.649E+00	1.809E+00	3.416E+00	2.829E+01	1.566E-01	2.478E-01	1.077E-01	8.932E-02	1.363E-01	1.611E+00	3.558E-03	2.218E-01	2.152E-03	8.534E-03	7.203E-02	6.225E-04
U-238	1977	18	1.329E-04	6.248E-05	1.777E-05	3.551E-05	5.549E-05	1.874E-04	9.667E-05	3.412E-02	8.654E-05	1.104E-04	5.558E-05	1.831E-03	6.538E-06	1.926E-02	4.529E-06	1.076E-05	5.252E-06	1.339E-06
U-234	1977	18	1.691E-02	1.176E-02	4.368E-03	5.952E-03	6.689E-03	1.579E-03	1.230E-02	5.150E-02	3.071E-03	6.115E-03	6.502E-03	2.341E-01	1.505E-04	3.884E-01	4.281E-06	1.092E-03	1.518E-05	1.250E-06
Th-230	1977	18	0.000E+00	1.653E-06	8.680E-07	5.879E-07	4.738E-07	2.728E-08	6.873E-11	1.687E-10	4.336E-08	4.335E-08	3.230E-09	0.000E+00	0.000E+00	1.144E-05	0.000E+00	0.000E+00	3.640E-09	0.000E+00
Ra-226	1977	18	3.010E-09	4.421E-07	2.319E-07	1.576E-07	1.268E-07	1.104E-10	2.190E-09	1.710E-09	3.136E-10	8.557E-10	1.171E-09	4.163E-08	2.580E-11	8.111E-09	0.000E+00	1.932E-10	1.498E-11	0.000E+00
Pb-210	1977	18	0.000E+00	3.113E-09	1.635E-09	1.108E-09	8.892E-10	0.000E+00	0.000E+00	0.000E+00	1.010E-12	1.010E-12	3.485E-11	0.000E+00	0.000E+00	2.668E-10	0.000E+00	0.000E+00	6.216E-11	0.000E+00
Tc-99A	1977	18	1.350E+00	1.024E+00	1.791E+00	1.170E+00	4.757E-01	1.777E+00	4.492E-01	5.390E-01	7.959E-01	6.562E-01	1.050E+00	5.170E-01	9.587E-01	6.404E-01	4.597E-01	3.213E-01	3.034E-01	1.819E-04
I-129A	1977	18	0.000E+00	8.678E-08	1.215E-06	4.440E-07	2.846E-07	8.007E-08	4.419E-07	3.701E-06	2.401E-07	3.058E-07	4.085E-07	7.620E-08	1.408E-06	7.866E-07	1.159E-06	5.639E-07	4.748E-07	3.427E-07
Cl-36A	1977	18	7.860E-04	9.648E-04	5.746E-03	2.376E-03	1.494E-03	9.860E-04	2.280E-03	1.579E-02	1.395E-03	1.704E-03	1.967E-03	7.107E-04	6.151E-03	3.761E-03	5.038E-03	2.572E-03	2.199E-03	1.420E-03
Tc-99B	1977	18	7.509E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.351E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.359E-03	0.000E+00
I-129B	1977	18	5.529E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.089E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.086E-05	0.000E+00
Cl-36B	1977	18	4.889E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.663E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.580E-02	0.000E+00
Tc-99F	1977	18	3.423E-02	1.400E-02	4.370E-03	9.034E-03	1.079E-02	1.050E-03	2.490E-02	1.950E-02	3.220E-03	9.400E-03	1.309E-02	4.743E-01	2.930E-04	0.000E+00	0.000E+00	2.210E-03	9.290E-09	0.000E+00
I-129F	1977	18	7.077E-05	2.890E-05	9.030E-06	1.860E-05	2.222E-05	2.160E-06	5.130E-05	4.020E-05	6.640E-06	1.937E-05	2.711E-05	9.786E-04	6.060E-07	0.000E+00	0.000E+00	4.570E-06	1.920E-11	0.000E+00
Cl-36F	1977	18	1.158E-06	4.730E-07	1.480E-07	3.046E-07	3.634E-07	3.530E-08	8.390E-07	6.570E-07	1.086E-07	3.167E-07	4.429E-07	1.601E-05	9.900E-09	0.000E+00	0.000E+00	7.460E-08	3.130E-13	0.000E+00
Tc-99R	1977	18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129R	1977	18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36R	1977	18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Tc-99V	1977	18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-129V	1977	18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cl-36V	1977	18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Table B-17. (continued).

SVRs	Inventory		Consecutive Year of Burial																	
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Tc-99W	1977	18	0.000E+00	2.601E-01	1.256E-01	8.442E-02	1.456E-01	1.103E+00	2.774E-03	6.821E-03	4.392E-03	2.850E-03	2.056E-03	0.000E+00	1.173E-05	1.796E-01	1.869E-04	0.000E+00	0.000E+00	0.000E+00
I-129W	1977	18	0.000E+00	4.150E-04	2.019E-04	1.366E-04	2.412E-04	1.808E-03	4.559E-06	1.119E-05	7.216E-06	4.689E-06	3.900E-06	0.000E+00	4.715E-08	3.070E-04	7.514E-07	0.000E+00	0.000E+00	0.000E+00
Cl-36W	1977	18	0.000E+00	4.202E-04	8.400E-04	2.508E-12	1.517E-08	9.557E-09	1.047E-10	7.599E-10	6.584E-07	6.582E-07	2.044E-10	0.000E+00	0.000E+00	1.738E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14A																				
C-14B																				
C-14F																				
C-14R																				
C-14W																				
Nb-94	1977	18	5.512E-01	9.168E+00	9.002E-01	5.479E-01	2.809E-01	6.097E+00	2.377E-01	7.090E-01	3.579E-01	3.076E-01	7.177E-01	2.222E-01	5.858E-01	3.653E-01	3.934E-01	2.429E-01	3.128E-01	4.546E-02
Sr-90	1977	18	2.024E+02	8.368E+01	2.602E+01	5.351E+01	6.400E+01	6.705E+00	1.470E+02	1.154E+02	1.909E+01	5.553E+01	7.848E+01	2.802E+03	1.878E+00	7.706E-02	1.936E-01	1.321E+01	2.511E-01	3.357E-02
N-14	1977	1	0.000E+00																	
Cr-52	1977	1	0.000E+00																	
CT-154	1979	1	0.000E+00																	
MC-85	1979	1	0.000E+00																	
PCE-166	1979	1	0.000E+00																	
DIO-88	1979	1	2.393E-01																	

Units:
- Ci for radionuclides
- gm for VOCs and inorganics (non-radionuclides)

Suffixes:
- A = activated metal
- B = beryllium blocks
- c = colloidal
- F = fuel-like materials
- R = resins
- V = Vycor
- W = surface wash

Table B-18. Inventory allocated to P17-20 by year.

P17-20	Inventory		Consecutive Year of Burial																	
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Am-241	1982	18	2.201E-02	6.410E-02	3.196E-02	1.961E-02	1.814E-02	9.517E-02	1.932E-02	2.252E-02	1.691E-02	2.213E-03	5.275E-02	6.439E-02	4.203E-01	4.204E-01	4.203E-01	4.203E-01	4.203E-01	4.203E-01
Np-237	1982	18	2.050E-05	3.731E-05	2.165E-05	4.430E-05	1.988E-05	1.242E-04	2.591E-05	3.473E-05	1.338E-05	9.946E-06	8.515E-05	1.026E-04	1.559E-03	1.559E-03	1.559E-03	1.559E-03	1.559E-03	1.559E-03
U-233	1982	18	2.226E-09	5.640E-09	4.603E-06	4.561E-09	4.566E-09	6.852E-08	2.287E-09	1.995E-08	3.866E-09	2.386E-08	5.855E-08	7.463E-08	5.934E-02	5.934E-02	5.934E-02	5.934E-02	5.934E-02	5.934E-02
Th-229	1982	18	2.862E-11	6.980E-11	3.034E-11	1.652E-11	2.385E-11	8.186E-11	2.258E-11	1.732E-11	2.536E-11	2.986E-12	2.233E-11	2.745E-11	1.090E-06	1.090E-06	1.090E-06	1.090E-06	1.090E-06	1.090E-06
Am-243	1982	18	1.014E-04	2.492E-04	1.209E-04	6.682E-05	8.629E-05	2.468E-04	8.623E-05	4.853E-05	8.928E-05	1.172E-05	1.454E-06	4.651E-07	8.853E-07	8.853E-07	8.853E-07	8.853E-07	8.853E-07	8.853E-07
Pu-239c	1982	18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-239	1982	18	6.327E-02	3.511E-02	5.511E-02	5.621E-01	1.543E-01	8.290E-01	5.550E-01	4.224E-01	5.229E-02	9.884E-03	9.076E-01	6.803E-01	2.791E-02	2.792E-02	2.791E-02	2.791E-02	2.791E-02	2.791E-02
U-235	1982	18	1.398E-05	1.220E-05	3.370E-05	5.493E-04	3.015E-03	1.446E-02	1.769E-02	5.598E-03	7.485E-04	7.164E-06	2.705E-03	3.475E-03	4.573E-02	4.573E-02	4.573E-02	4.573E-02	4.573E-02	4.573E-02
Pa-231	1982	18	3.470E-09	8.512E-09	4.215E-09	2.440E-09	3.001E-09	1.516E-08	3.003E-09	2.973E-09	3.113E-09	3.983E-10	1.019E-08	7.842E-09	1.430E-04	1.430E-04	1.430E-04	1.430E-04	1.430E-04	1.430E-04
Ac-227	1982	18	3.470E-09	8.512E-09	4.215E-09	2.440E-09	3.001E-09	1.516E-08	3.003E-09	2.973E-09	3.113E-09	3.983E-10	1.019E-08	7.842E-09	1.601E-07	1.601E-07	1.601E-07	1.601E-07	1.601E-07	1.601E-07
Pu-240c	1982	18	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Pu-240	1982	18	3.967E-03	1.276E-02	4.012E-03	1.138E-02	5.262E-03	8.943E-02	1.048E-02	2.134E-02	3.574E-03	4.284E-04	1.210E-01	9.302E-02	1.616E-02	1.616E-02	1.616E-02	1.616E-02	1.616E-02	1.616E-02
U-236	1982	18	2.995E-05	2.696E-05	3.284E-05	1.778E-04	5.228E-05	8.826E-04	1.363E-04	2.318E-04	2.394E-05	2.382E-05	1.225E-03	9.408E-04	9.287E-03	9.287E-03	9.287E-03	9.287E-03	9.287E-03	9.287E-03
Th-232	1982	18	9.176E-08	2.015E-08	7.548E-08	8.600E-07	2.220E-07	3.929E-07	8.619E-07	4.862E-07	6.493E-08	2.323E-08	1.328E-07	3.983E-08	4.298E-03	4.298E-03	4.298E-03	4.298E-03	4.298E-03	4.298E-03
Ra-228	1982	18	2.021E-12	4.942E-12	2.383E-12	1.285E-12	1.699E-12	4.810E-12	1.712E-12	9.690E-13	1.806E-12	2.347E-13	1.800E-14	6.000E-16	1.785E-06	1.785E-06	1.785E-06	1.785E-06	1.785E-06	1.785E-06
Pu-238	1982	18	1.630E-01	3.810E-01	1.969E-01	1.373E-01	1.344E-01	4.030E-01	1.446E-01	8.715E-02	1.319E-01	3.370E-02	4.986E-02	3.649E-02	2.446E-02	2.448E-02	2.446E-02	2.446E-02	2.446E-02	2.446E-02
U-238	1982	18	9.385E-05	4.087E-05	2.232E-04	1.799E-04	4.233E-03	3.475E-02	6.058E-03	3.739E-03	9.601E-05	5.861E-07	4.073E-03	3.215E-03	6.490E-01	6.490E-01	6.490E-01	6.490E-01	6.490E-01	6.490E-01
U-234	1982	18	3.779E-04	5.819E-04	8.985E-04	1.251E-02	6.691E-02	3.355E-01	3.914E-01	1.269E-01	1.690E-02	6.988E-05	8.238E-02	9.412E-02	4.159E-01	4.159E-01	4.159E-01	4.159E-01	4.159E-01	4.159E-01
Th-230	1982	18	5.155E-08	1.303E-07	6.235E-08	5.930E-08	7.034E-08	1.675E-06	4.466E-08	3.166E-07	6.875E-08	4.948E-09	1.502E-06	1.865E-06	2.236E-03	2.236E-03	2.236E-03	2.236E-03	2.236E-03	2.236E-03
Ra-226	1982	18	1.339E-08	3.264E-08	1.408E-08	7.673E-09	1.120E-08	2.887E-08	1.081E-08	6.579E-09	1.203E-08	1.306E-09	1.223E-09	3.141E-11	1.319E-02	1.319E-02	1.319E-02	1.319E-02	1.319E-02	1.319E-02
Pb-210	1982	18	9.382E-11	2.299E-10	1.005E-10	5.254E-11	7.898E-11	2.257E-10	7.512E-11	5.085E-11	8.358E-11	9.201E-12	3.585E-11	4.354E-11	8.489E-08	8.489E-08	8.489E-08	8.489E-08	8.489E-08	8.489E-08
Tc-99A	1982	16	1.698E-04	0.000E+00	2.251E-06	1.633E-06	0.000E+00	5.389E-05	3.189E-05	0.000E+00	0.000E+00	6.132E-04	7.814E-07	1.409E-08	2.281E-08	0.000E+00	3.611E-09	0.000E+00		
I-129A	1982	16	0.000E+00	0.000E+00	3.690E-09	2.677E-09	0.000E+00	9.469E-08	9.164E-08	0.000E+00	0.000E+00	1.005E-06	1.296E-09	2.654E-11	4.299E-11	0.000E+00	6.806E-12	0.000E+00		
Cl-36A	1982	16	1.184E-07	0.000E+00	1.598E-09	1.820E-13	0.000E+00	7.065E-12	1.469E-11	0.000E+00	0.000E+00	6.833E-11	5.633E-08	1.096E-07	1.781E-07	0.000E+00	2.820E-08	0.000E+00		
Tc-99B	1982	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
I-129B	1982	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
Cl-36B	1982	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
Tc-99F	1982	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
I-129F	1982	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
Cl-36F	1982	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
Tc-99R	1982	16	0.000E+00	0.000E+00	3.935E-02	9.799E-02	7.438E-02	1.090E-01	9.493E-02	8.122E-02	9.575E-02	7.965E-02	7.336E-02	4.403E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
I-129R	1982	16	0.000E+00	0.000E+00	9.784E-04	2.437E-03	1.850E-03	2.710E-03	2.360E-03	2.020E-03	2.381E-03	1.981E-03	1.824E-03	1.095E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
Cl-36R	1982	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
Tc-99V	1982	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
I-129V	1982	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
Cl-36V	1982	16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00		

Table B-18. (continued).

P17-20	Inventory		Consecutive Year of Burial																	
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Tc-99W	1982	16	8.063E-03	1.834E-02	2.644E-02	1.019E-02	7.667E-03	4.388E-02	1.032E-02	1.069E-02	7.012E-03	1.015E-03	3.793E-02	2.893E-02	3.808E-06	8.653E-05	6.998E-07	1.754E-07		
I-129W	1982	16	1.313E-05	2.950E-05	8.365E-05	1.836E-05	1.290E-05	7.299E-05	1.850E-05	1.850E-05	1.132E-05	1.857E-06	6.337E-05	4.825E-05	1.531E-08	3.478E-07	2.813E-09	7.051E-10		
Cl-36W	1982	16	1.463E-08	3.192E-09	1.515E-07	6.259E-07	4.766E-07	2.482E-05	2.437E-07	4.864E-06	3.867E-07	4.189E-09	3.676E-05	2.835E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00		
C-14A																				
C-14B																				
C-14F																				
C-14R																				
C-14W																				
Nb-94	1982	18	6.878E-05	0.000E+00	1.206E-05	8.710E-06	0.000E+00	3.382E-04	7.034E-04	0.000E+00	0.000E+00	3.271E-03	5.976E-06	3.509E-06	9.508E-02	9.507E-02	9.508E-02	9.507E-02	9.507E-02	9.507E-02
Sr-90	1982	18	0.000E+00	0.000E+00	1.492E-02	1.082E-02	0.000E+00	3.829E-01	3.706E-01	0.000E+00	0.000E+00	4.065E+00	5.187E-03	2.946E-06	4.717E-02	4.717E-02	4.717E-02	4.717E-02	4.717E-02	4.717E-02
N-14	1982	1	0.000E+00																	
Cr-52	1982	1	0.000E+00																	
CT-154	1982	1	0.000E+00																	
MC-85	1982	1	0.000E+00																	
PCE-166	1982	1	0.000E+00																	
DIO-88	1982	1	2.393E+00																	

Units:
- Ci for radionuclides
- gm for VOCs and inorganics (non-radionuclides)

Suffixes:
- A = activated metal
- B = beryllium blocks
- c = colloidal
- F = fuel-like materials
- R = resins
- V = Vycor
- W = surface wash

Table B-19. Inventory allocated to LLW Proj by year.

LLW Proj	Inventory		Consecutive Year of Burial
Nuclide	Year 1	Years	1
Am-241	2000	1	1.187E+00
Np-237	2000	1	2.280E-02
U-233	2000	1	1.740E-02
Th-229	2000	1	0.000E+00
Am-243	2000	1	1.880E-03
Pu-239c	2000	1	0.000E+00
Pu-239	2000	1	5.070E-01
U-235	2000	1	3.820E-02
Pa-231	2000	1	0.000E+00
Ac-227	2000	1	0.000E+00
Pu-240c	2000	1	0.000E+00
Pu-240	2000	1	1.830E-01
U-236	2000	1	1.750E-02
Th-232	2000	1	2.750E-02
Ra-228	2000	1	2.570E-05
Pu-238	2000	1	4.910E-01
U-238	2000	1	7.390E+00
U-234	2000	1	4.070E-01
Th-230	2000	1	2.620E-02
Ra-226	2000	1	1.910E-01
Pb-210	2000	1	0.000E+00
Tc-99A	2000	1	3.457E-03
I-129A	2000	1	0.000E+00
Cl-36A	2000	1	5.380E-01
Tc-99B	2000	1	0.000E+00
I-129B	2000	1	0.000E+00
Cl-36B	2000	1	0.000E+00
Tc-99F	2000	1	0.000E+00
I-129F	2000	1	0.000E+00
Cl-36F	2000	1	0.000E+00
Tc-99R	2000	1	2.050E+00
I-129R	2000	1	4.649E-02
Cl-36R	2000	1	0.000E+00

Table B-19. (continued).

LLW Proj	Inventory		Consecutive Year of Burial
Nuclide	Year 1	Years	1
Tc-99V	2000	1	0.000E+00
I-129V	2000	1	0.000E+00
Cl-36V	2000	1	0.000E+00
Tc-99W	2000	1	3.667E-02
I-129W	2000	1	2.707E-03
Cl-36W	2000	1	0.000E+00
C-14A			
C-14B			
C-14F			
C-14R			
C-14W			
Nb-94	2000	1	2.829E+00
Sr-90	2000	1	0.000E+00
N-14	2000	1	0.000E+00
Cr-52	2000	1	0.000E+00
CT-154	2000	1	0.000E+00
MC-85	2000	1	0.000E+00
PCE-166	2000	1	0.000E+00
DIO-88	2000	1	0.000E+00

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-20. Inventory allocated to Pre-60 by year.

Pre-60	Inventory		Consecutive Year of Burial
Nuclide	Year 1	Years	1
Am-241			
Np-237			
U-233			
Th-229			
Am-243			
Pu-239c			
Pu-239			
U-235			
Pa-231			
Ac-227			
Pu-240c			
Pu-240			
U-236			
Th-232			
Ra-228			
Pu-238			
U-238			
U-234			
Th-230			
Ra-226			
Pb-210			
Tc-99A			
I-129A			
Cl-36A			
Tc-99B			
I-129B			
Cl-36B			
Tc-99F			
I-129F			
Cl-36F			
Tc-99R			
I-129R			
Cl-36R			

Table B-20. (continued).

Pre-60	Inventory		Consecutive Year of Burial
Nuclide	Year 1	Years	1
Tc-99V			
I-129V			
Cl-36V			
Tc-99W			
I-129W			
Cl-36W			
C-14A	1954	6	6.570E-05
C-14B	1954	6	0.000E+00
C-14F	1954	6	0.000E+00
C-14R	1954	6	6.562E-02
C-14W	1954	6	0.000E+00
Nb-94			
Sr-90			
N-14			
Cr-52			
CT-154			
MC-85			
PCE-166			
DIO-88			

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-21. Inventory allocated to 60-66 by year.

60-66	Inventory		Consecutive Year of Burial						
Nuclide	Year 1	Years	1	2	3	4	5	6	7
Am-241									
Np-237									
U-233									
Th-229									
Am-243									
Pu-239c									
Pu-239									
U-235									
Pa-231									
Ac-227									
Pu-240c									
Pu-240									
U-236									
Th-232									
Ra-228									
Pu-238									
U-238									
U-234									
Th-230									
Ra-226									
Pb-210									
Tc-99A									
I-129A									

Table B-21. (continued).

60-66	Inventory		Consecutive Year of Burial						
Nuclide	Year 1	Years	1	2	3	4	5	6	7
Cl-36A									
Tc-99B									
I-129B									
Cl-36B									
Tc-99F									
I-129F									
Cl-36F									
Tc-99R									
I-129R									
Cl-36R									
Tc-99V									
I-129V									
Cl-36V									
Tc-99W									
I-129W									
Cl-36W									
C-14A	1960	7	3.565E+00	4.955E+01	9.497E+00	4.847E+01	3.404E+00	9.028E+01	2.631E+01
C-14B	1960	7	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14F	1960	7	8.212E-09	5.229E-05	4.916E-04	6.494E+00	2.210E-03	2.406E-04	3.536E-04
C-14R	1960	7	1.429E-02	4.643E-02	1.123E-02	2.612E-02	1.279E-02	2.743E+00	1.851E-02
C-14W	1960	7	5.072E-01	8.038E-01	3.985E+00	5.106E+01	7.537E-02	1.152E+00	8.631E-02
Nb-94									
Sr-90									
N-14									

Table B-21. (continued).

60-66	Inventory		Consecutive Year of Burial						
Nuclide	Year 1	Years	1	2	3	4	5	6	7
Cr-52									
CT-154									
MC-85									
PCE-166									
DIO-88									

Units:
- Ci for radionuclides
- gm for VOCs and inorganics (non-radionuclides)

Suffixes:
- A = activated metal
- B = beryllium blocks
- c = colloidal
- F = fuel-like materials
- R = resins
- V = Vycor
- W = surface wash

Table B-22. Inventory allocated to 67-83 by year.

67-83	Inventory		Consecutive Year of Burial																
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Am-241																			
Np-237																			
U-233																			
Th-229																			
Am-243																			
Pu-239c																			
Pu-239																			
U-235																			
Pa-231																			
Ac-227																			
Pu-240c																			
Pu-240																			
U-236																			
Th-232																			
Ra-228																			
Pu-238																			
U-238																			
U-234																			
Th-230																			
Ra-226																			
Pb-210																			
Tc-99A																			
I-129A																			
Cl-36A																			
Tc-99B																			
I-129B																			
Cl-36B																			
Tc-99F																			
I-129F																			
Cl-36F																			
Tc-99R																			
I-129R																			
Cl-36R																			
Tc-99V																			

Table B-22. (continued).

67-83	Inventory		Consecutive Year of Burial																
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
I-129V																			
Cl-36V																			
Tc-99W																			
I-129W																			
Cl-36W																			
C-14A	1967	17	9.526E+00	6.860E+00	3.020E+01	1.285E+01	3.249E+00	1.688E-01	5.665E-01	5.826E-02	1.391E+00	2.358E+00	7.283E+00	3.913E+01	5.177E+00	2.934E+00	1.797E+00	2.713E+01	1.604E+00
C-14B	1967	17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14F	1967	17	2.276E-03	3.177E-02	3.902E-03	1.890E-03	3.790E-03	4.270E-03	1.360E-03	4.290E-04	2.100E-03	1.582E-03	9.375E-04	7.710E-04	1.941E-04	2.468E-04	2.941E-04	6.901E-05	1.387E-03
C-14R	1967	17	1.319E+01	4.330E-02	5.501E-02	1.516E-01	4.709E-02	1.857E-02	6.893E-03	9.062E-03	1.027E-02	1.022E-02	9.185E-03	1.020E-02	9.610E-03	1.391E-02	8.506E-03	8.573E-03	1.069E-02
C-14W	1967	17	2.092E-01	5.014E-02	5.471E-02	2.556E-02	1.250E-02	4.998E+00	1.732E-01	3.373E-01	6.271E-02	8.045E-03	8.478E-03	3.037E+01	1.068E-02	3.132E-03	1.672E+00	1.892E+00	2.743E-02
Nb-94																			
Sr-90																			
N-14																			
Cr-52																			
CT-154																			
MC-85																			
PCE-166																			
DIO-88																			

Units:
- Ci for radionuclides
- gm for VOCs and inorganics (non-radionuclides)

Suffixes:
- A = activated metal
- B = beryllium blocks
- c = colloidal
- F = fuel-like materials
- R = resins
- V = Vycor
- W = surface wash

Table B-23. Inventory allocated to Post-83 by year.

Post-83	Inventory		Consecutive Year of Burial																
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Am-241																			
Np-237																			
U-233																			
Th-229																			
Am-243																			
Pu-239c																			
Pu-239																			
U-235																			
Pa-231																			
Ac-227																			
Pu-240c																			
Pu-240																			
U-236																			
Th-232																			
Ra-228																			
Pu-238																			
U-238																			
U-234																			
Th-230																			
Ra-226																			
Pb-210																			
Tc-99A																			
I-129A																			
Cl-36A																			
Tc-99B																			
I-129B																			
Cl-36B																			
Tc-99F																			
I-129F																			
Cl-36F																			
Tc-99R																			
I-129R																			
Cl-36R																			
Tc-99V																			

Table B-23. (continued).

Post-83	Inventory		Consecutive Year of Burial																
Nuclide	Year 1	Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
I-129V																			
Cl-36V																			
Tc-99W																			
I-129W																			
Cl-36W																			
C-14A	1984	17	5.251E+00	2.070E+00	1.976E+00	4.380E+00	1.309E+00	3.508E+00	2.417E+00	2.483E+00	1.694E+00	2.090E+00	1.705E+00	1.362E+00	1.362E+00	1.362E+00	1.362E+00	1.362E+00	7.164E+01
C-14B	1984	17	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14F	1984	17	5.330E-04	8.810E-05	2.571E-04	3.590E-04	1.291E-02	8.020E-06	0.000E+00	0.000E+00	6.050E-05	2.540E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14R	1984	17	1.088E-02	1.000E-02	7.592E-03	1.112E-02	9.689E-03	8.289E-03	9.772E-03	8.129E-03	7.487E-03	4.494E-03	2.316E-01	2.316E-01	2.316E-01	2.316E-01	2.316E-01	2.316E-01	7.863E+00
C-14W	1984	17	1.531E-01	1.016E-01	4.973E-02	4.048E-02	1.112E-04	1.594E-04	1.007E-05	3.104E-06	1.747E-05	5.434E-06	8.157E-02	8.157E-02	8.157E-02	8.157E-02	8.157E-02	8.157E-02	5.116E+00
Nb-94																			
Sr-90																			
N-14																			
Cr-52																			
CT-154																			
MC-85																			
PCE-166																			
DIO-88																			

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-24. Inventory allocated to TR52 by year.

TR52	Inventory		Consecutive Year of Burial			
Nuclide	Year 1	Years	1	2	3	4
Am-241						
Np-237						
U-233						
Th-229						
Am-243						
Pu-239c						
Pu-239						
U-235						
Pa-231						
Ac-227						
Pu-240c						
Pu-240						
U-236						
Th-232						
Ra-228						
Pu-238						
U-238						
U-234						
Th-230						
Ra-226						
Pb-210						
Tc-99A						
I-129A						
Cl-36A						
Tc-99B						
I-129B						
Cl-36B						
Tc-99F						
I-129F						
Cl-36F						
Tc-99R						
I-129R						
Cl-36R						
Tc-99V						

Table B-24. (continued).

TR52	Inventory		Consecutive Year of Burial			
Nuclide	Year 1	Years	1	2	3	4
I-129V						
Cl-36V						
Tc-99W						
I-129W						
Cl-36W						
C-14A	1970	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14B	1970	4	2.170E+01	0.000E+00	0.000E+00	3.004E-01
C-14F	1970	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14R	1970	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14W	1970	4	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Nb-94						
Sr-90						
N-14						
Cr-52						
CT-154						
MC-85						
PCE-166						
DIO-88						

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-25. Inventory allocated to TR58 by year.

TR58	Inventory		Consecutive Year of Burial	
Nuclide	Year 1	Years	1	2
Am-241				
Np-237				
U-233				
Th-229				
Am-243				
Pu-239c				
Pu-239				
U-235				
Pa-231				
Ac-227				
Pu-240c				
Pu-240				
U-236				
Th-232				
Ra-228				
Pu-238				
U-238				
U-234				
Th-230				
Ra-226				
Pb-210				
Tc-99A				
I-129A				
Cl-36A				
Tc-99B				
I-129B				
Cl-36B				
Tc-99F				
I-129F				
Cl-36F				
Tc-99R				
I-129R				
Cl-36R				

Table B-25. (continued).

TR58	Inventory		Consecutive Year of Burial	
Nuclide	Year 1	Years	1	2
Tc-99V				
I-129V				
Cl-36V				
Tc-99W				
I-129W				
Cl-36W				
C-14A	1976	2	0.000E+00	0.000E+00
C-14B	1976	2	7.511E+00	2.920E+01
C-14F	1976	2	0.000E+00	0.000E+00
C-14R	1976	2	0.000E+00	0.000E+00
C-14W	1976	2	0.000E+00	0.000E+00
Nb-94				
Sr-90				
N-14				
Cr-52				
CT-154				
MC-85				
PCE-166				
DIO-88				

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-26. Inventory allocated to SVR12 by year.

SVR12	Inventory		Consecutive Year of Burial
Nuclide	Year 1	Years	1
Am-241			
Np-237			
U-233			
Th-229			
Am-243			
Pu-239c			
Pu-239			
U-235			
Pa-231			
Ac-227			
Pu-240c			
Pu-240			
U-236			
Th-232			
Ra-228			
Pu-238			
U-238			
U-234			
Th-230			
Ra-226			
Pb-210			
Tc-99A			
I-129A			
Cl-36A			
Tc-99B			
I-129B			
Cl-36B			
Tc-99F			
I-129F			
Cl-36F			
Tc-99R			
I-129R			
Cl-36R			

Table B-26. (continued).

SVR12	Inventory		Consecutive Year of Burial
Nuclide	Year 1	Years	1
Tc-99V			
I-129V			
Cl-36V			
Tc-99W			
I-129W			
Cl-36W			
C-14A	1982	1	0.000E+00
C-14B	1982	1	5.834E+00
C-14F	1982	1	0.000E+00
C-14R	1982	1	0.000E+00
C-14W	1982	1	0.000E+00
Nb-94			
Sr-90			
N-14			
Cr-52			
CT-154			
MC-85			
PCE-166			
DIO-88			

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table. B-27. Inventory allocated to SVR17 by year.

SVR17	Inventory		Consecutive Year of Burial
Nuclide	Year 1	Years	1
Am-241			
Np-237			
U-233			
Th-229			
Am-243			
Pu-239c			
Pu-239			
U-235			
Pa-231			
Ac-227			
Pu-240c			
Pu-240			
U-236			
Th-232			
Ra-228			
Pu-238			
U-238			
U-234			
Th-230			
Ra-226			
Pb-210			
Tc-99A			
I-129A			
Cl-36A			
Tc-99B			
I-129B			
Cl-36B			
Tc-99F			
I-129F			
Cl-36F			
Tc-99R			
I-129R			
Cl-36R			

Table B-27. (continued).

SVR17	Inventory		Consecutive Year of Burial
Nuclide	Year 1	Years	1
Tc-99V			
I-129V			
Cl-36V			
Tc-99W			
I-129W			
Cl-36W			
C-14A	1987	1	0.000E+00
C-14B	1987	1	1.591E+01
C-14F	1987	1	0.000E+00
C-14R	1987	1	0.000E+00
C-14W	1987	1	0.000E+00
Nb-94			
Sr-90			
N-14			
Cr-52			
CT-154			
MC-85			
PCE-166			
DIO-88			

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Table B-28. Inventory allocated to SVR20 by year.

SVR20	Inventory		Consecutive Year of Burial
Nuclide	Year 1	Years	1
Am-241			
Np-237			
U-233			
Th-229			
Am-243			
Pu-239c			
Pu-239			
U-235			
Pa-231			
Ac-227			
Pu-240c			
Pu-240			
U-236			
Th-232			
Ra-228			
Pu-238			
U-238			
U-234			
Th-230			
Ra-226			
Pb-210			
Tc-99A			
I-129A			
Cl-36A			
Tc-99B			
I-129B			
Cl-36B			
Tc-99F			
I-129F			
Cl-36F			
Tc-99R			
I-129R			
Cl-36R			

Table B-28. (continued).

SVR20	Inventory		Consecutive Year of Burial
Nuclide	Year 1	Years	1
Tc-99V			
I-129V			
Cl-36V			
Tc-99W			
I-129W			
Cl-36W			
C-14A	1993	1	0.000E+00
C-14B	1993	1	1.196E+01
C-14F	1993	1	0.000E+00
C-14R	1993	1	0.000E+00
C-14W	1993	1	0.000E+00
Nb-94			
Sr-90			
N-14			
Cr-52			
CT-154			
MC-85			
PCE-166			
DIO-88			

Units:
Ci for radionuclides
gm for VOCs and inorganics (non-radionuclides)

Suffixes:
A = activated metal
B = beryllium blocks
c = colloidal
F = fuel-like materials
R = resins
V = Vycor
W = surface wash

Appendix C

Sensitivity Case Results

C-1. UPPER-BOUND INVENTORY SENSITIVITY CASE RESULTS

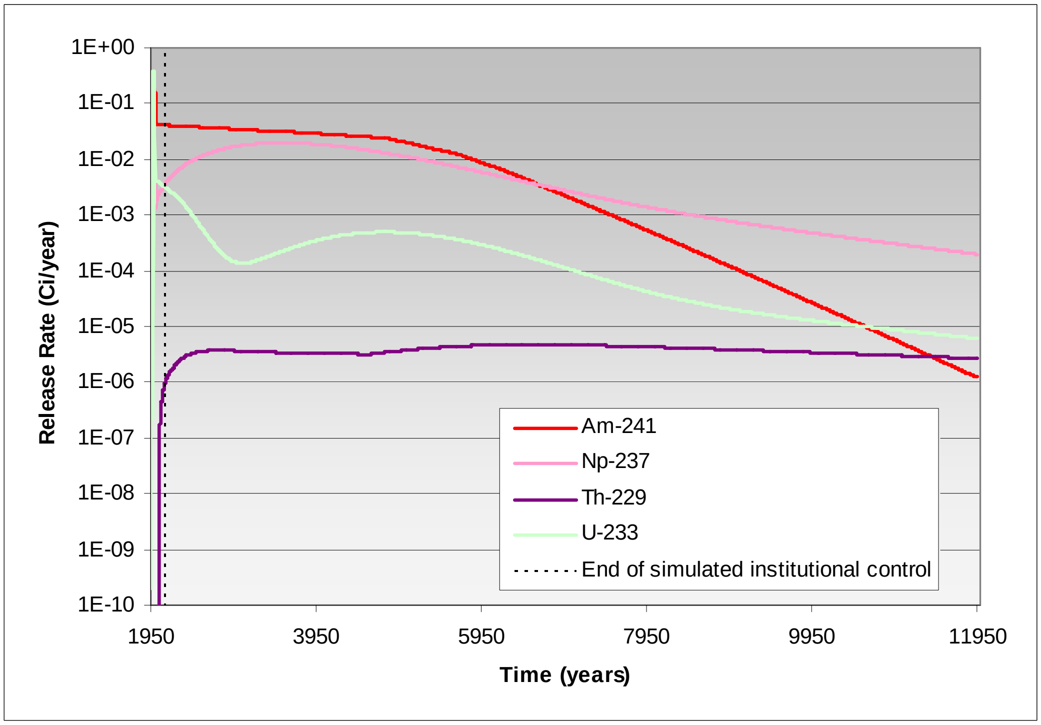


Figure C-1. Release of Group 1 contaminants from upper-bound inventory sensitivity case.

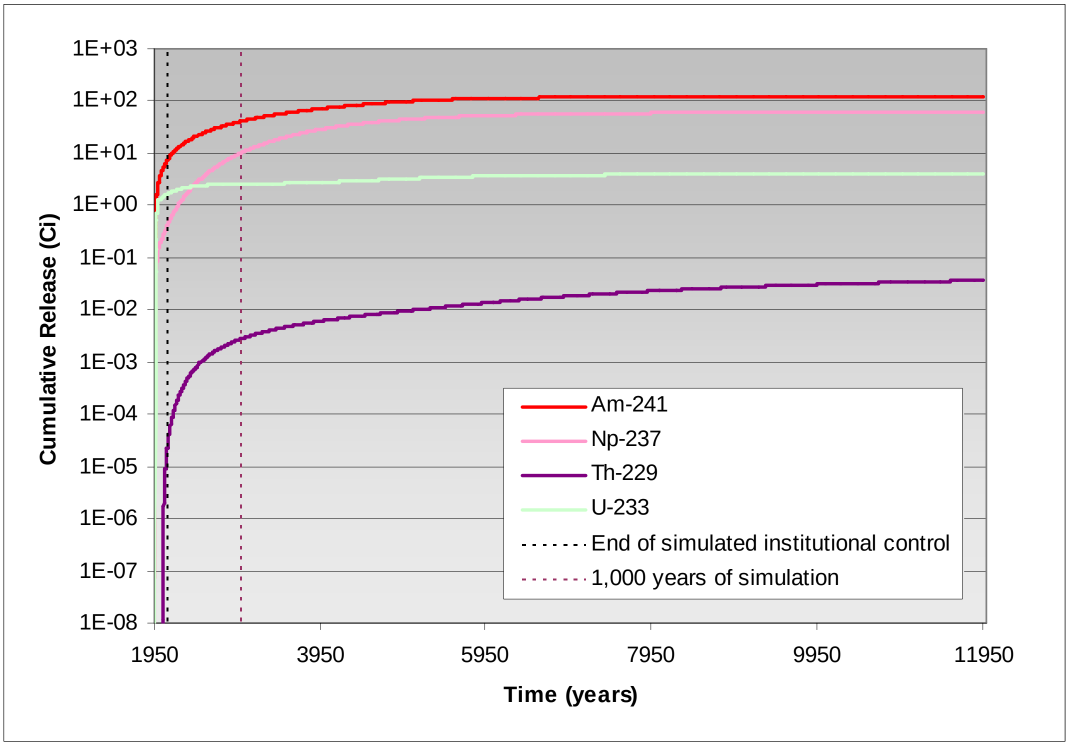


Figure C-2. Cumulative release of Group 1 contaminants from upper-bound inventory sensitivity case.

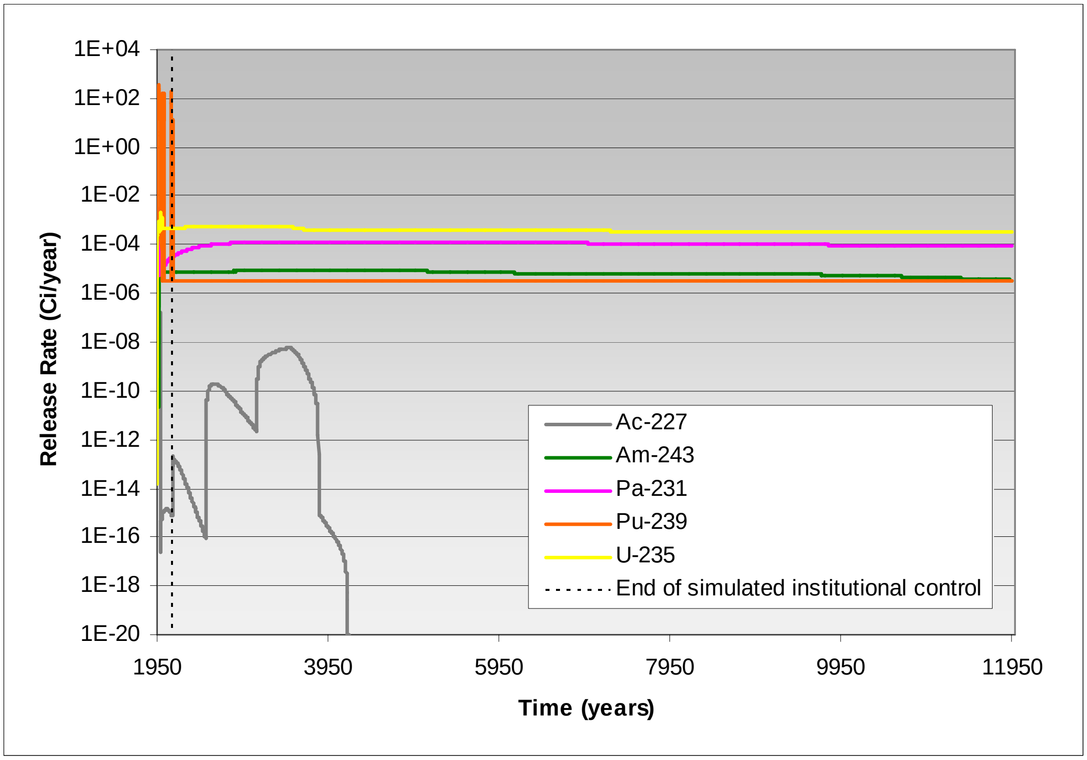


Figure C-3. Release of Group 2 contaminants from upper-bound inventory sensitivity case.

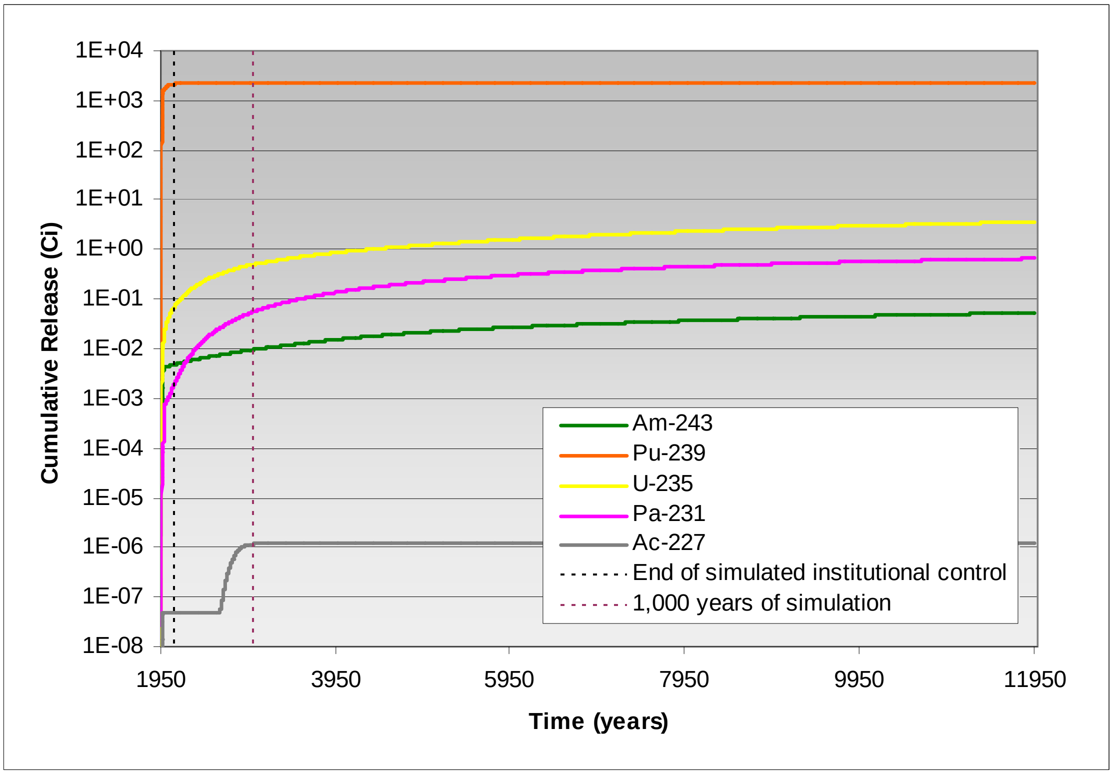


Figure C-4. Cumulative release of Group 2 contaminants from upper-bound inventory sensitivity case.

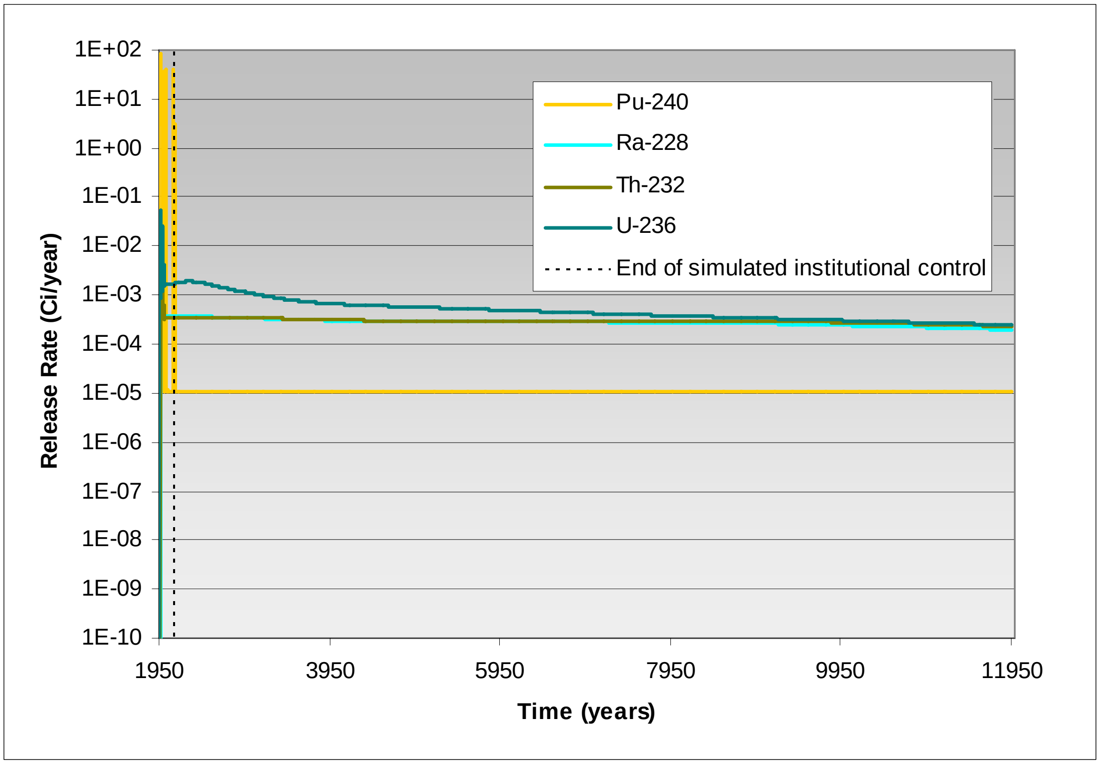


Figure C-5. Release of Group 3 contaminants from upper-bound inventory sensitivity case.

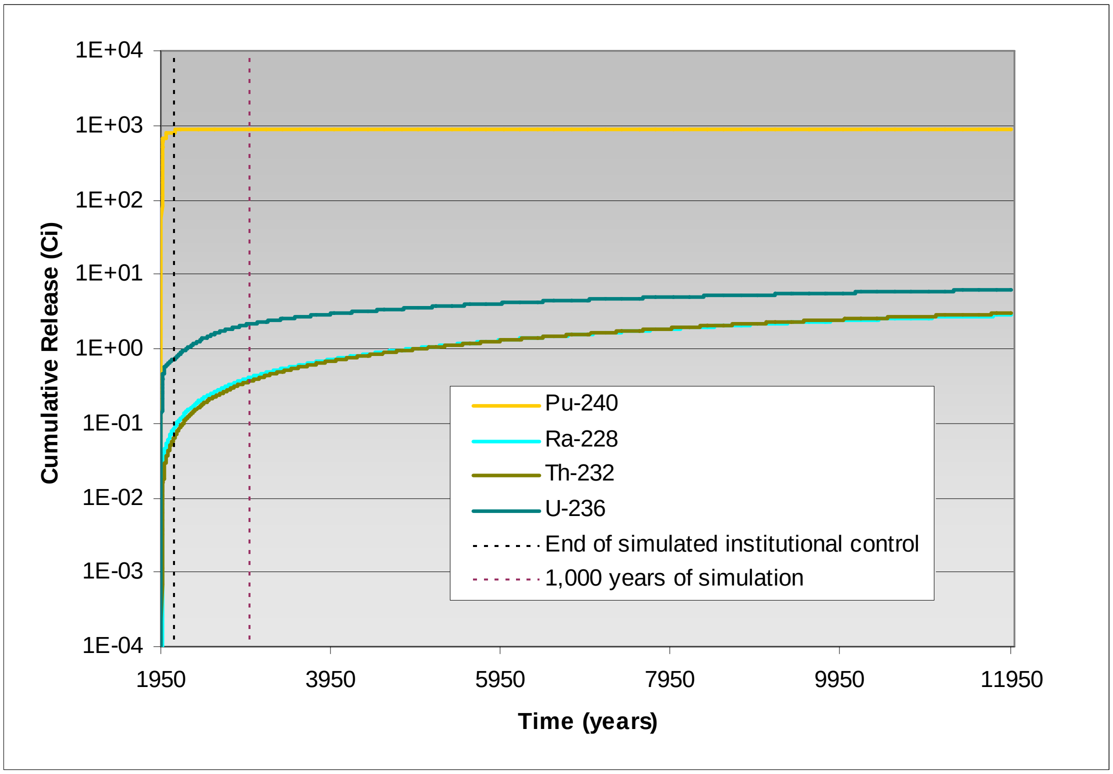


Figure C-6. Cumulative release of Group 3 contaminants from upper-bound inventory sensitivity case.

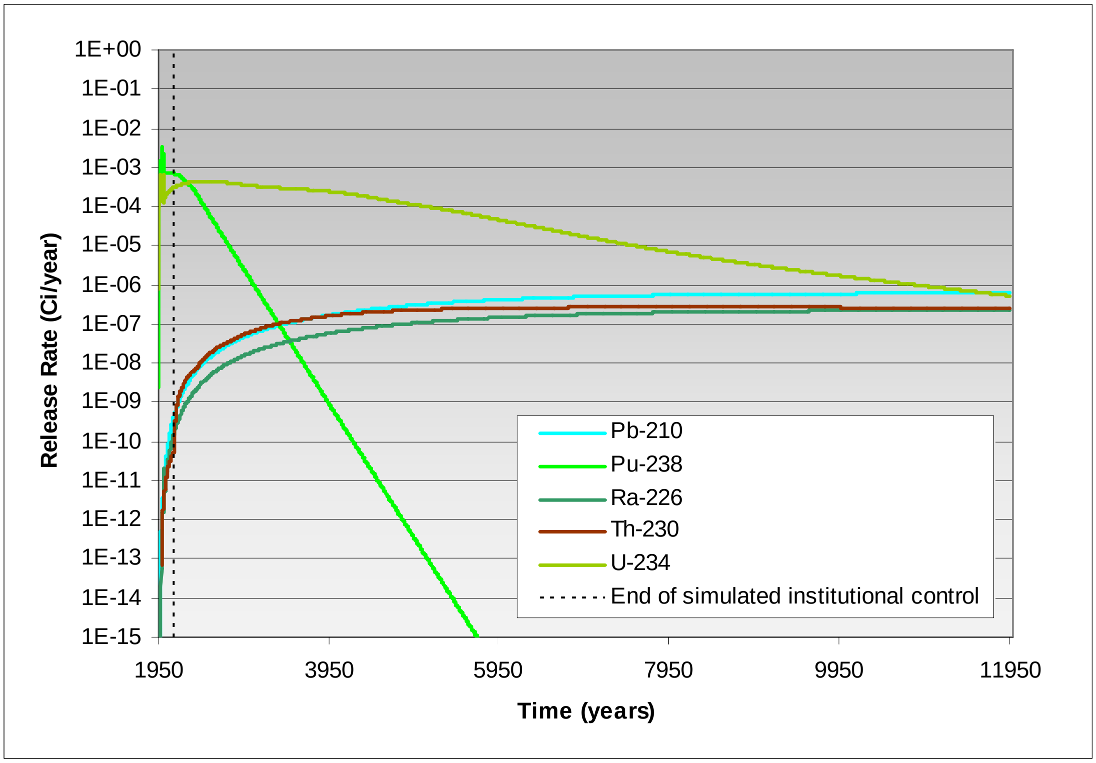


Figure C-7. Release of Group 4 contaminants from upper-bound inventory sensitivity case.

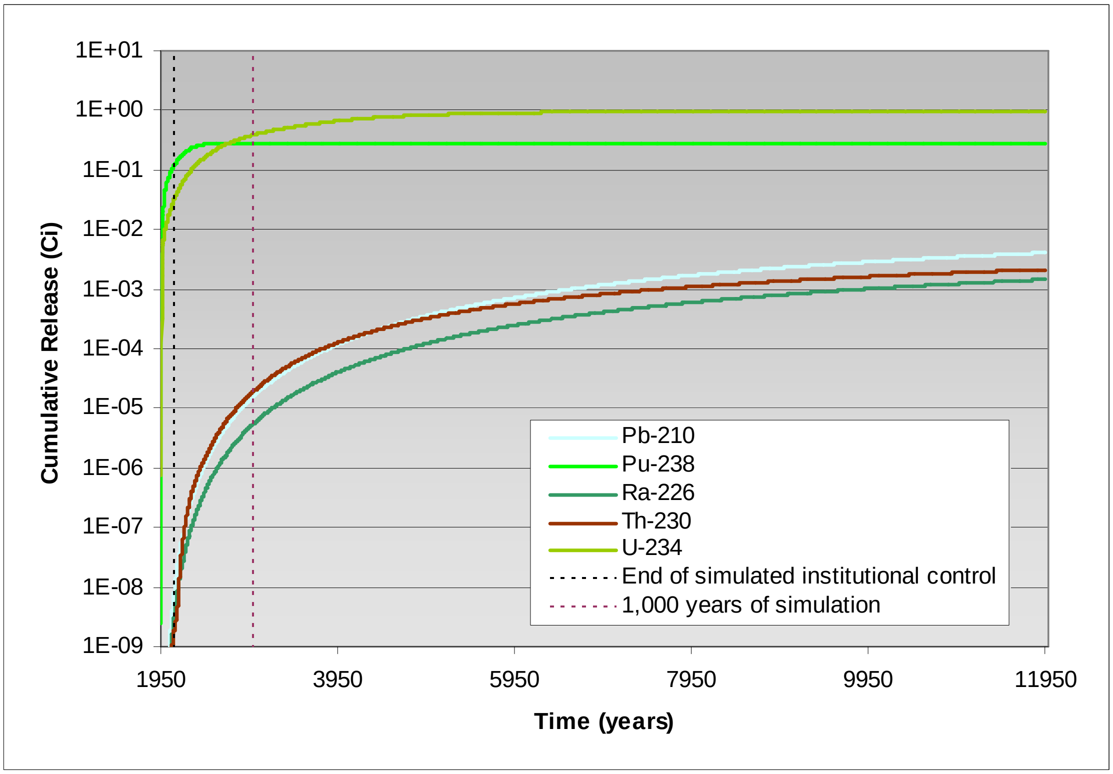


Figure C-8. Cumulative release of Group 4 contaminants from upper-bound inventory sensitivity case.

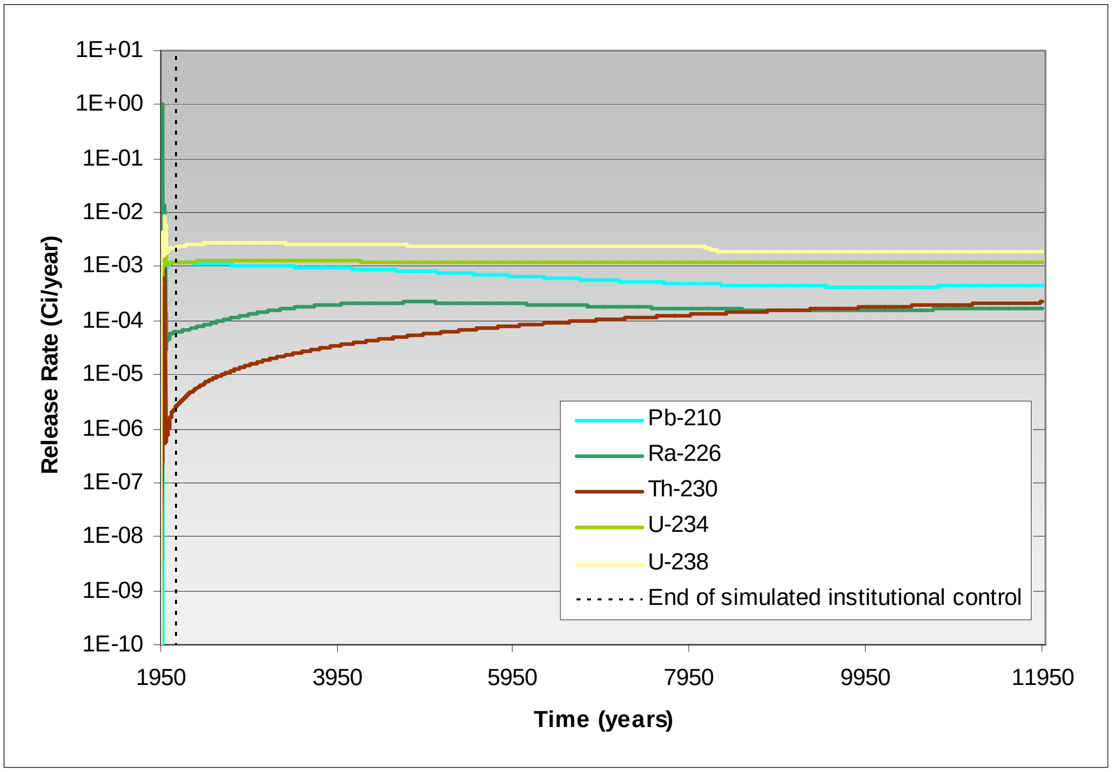


Figure C-9. Release of Group 5 contaminants from upper-bound inventory sensitivity case.

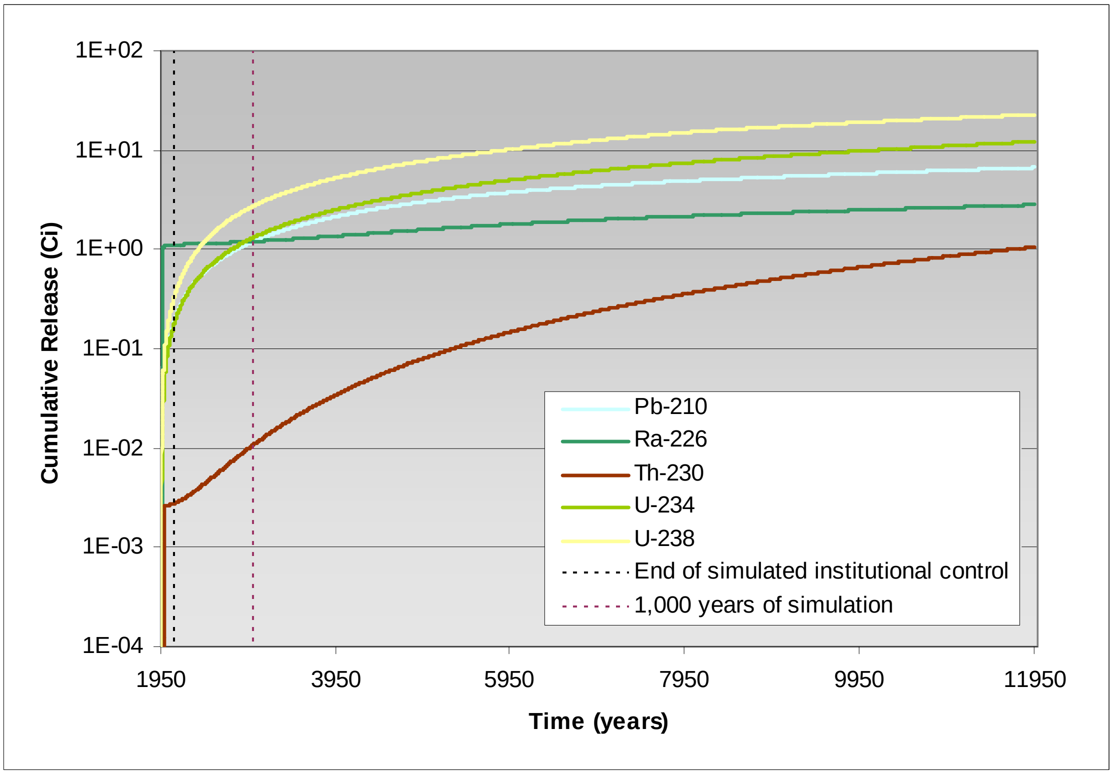


Figure C-10. Cumulative release of Group 5 contaminants from upper-bound inventory sensitivity case.

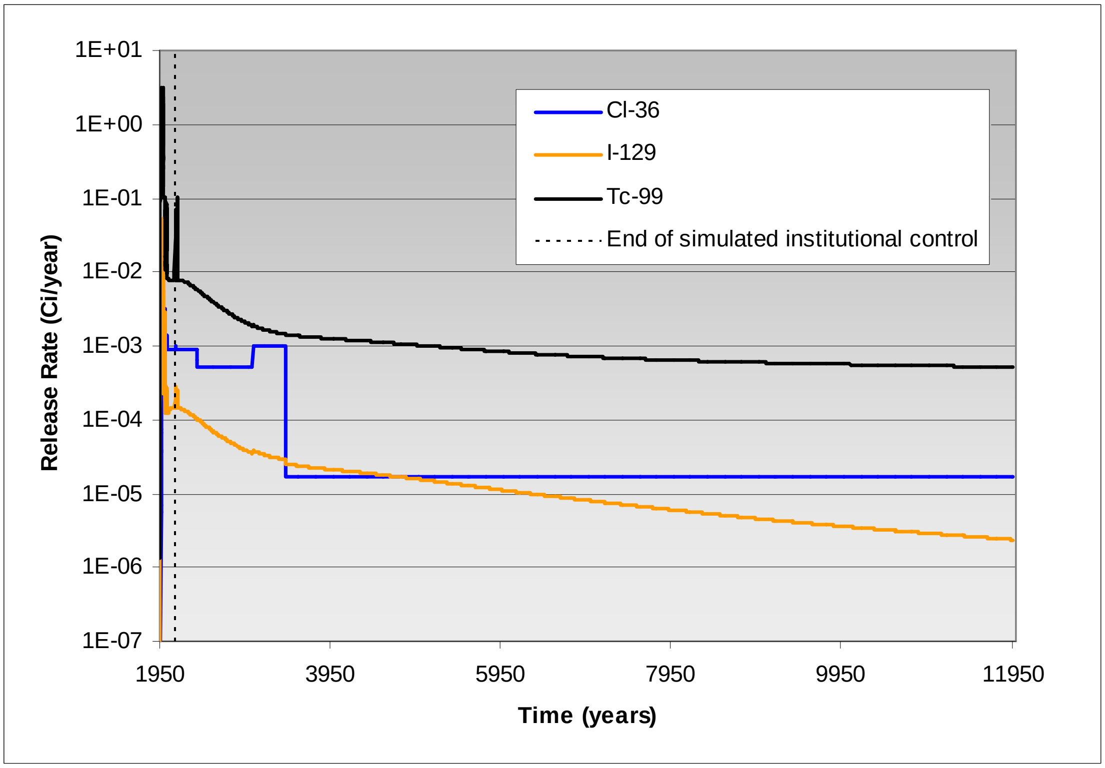


Figure C-11 Release of Group 6 contaminants from upper-bound inventory sensitivity case.

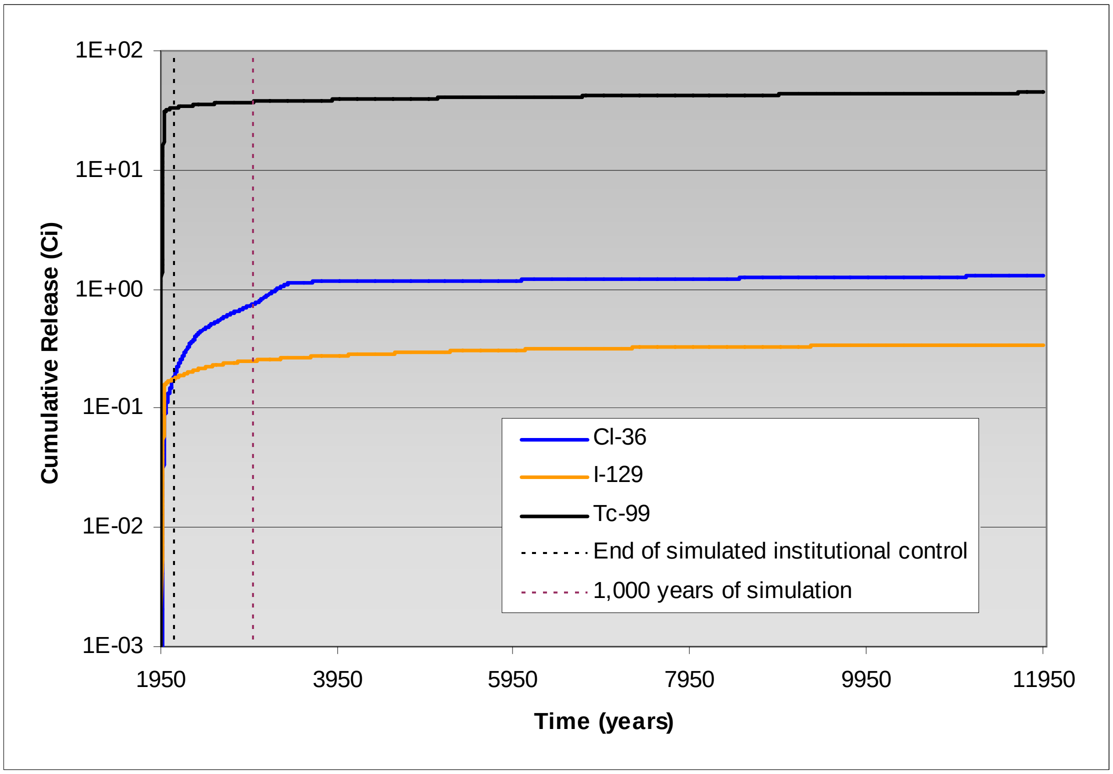


Figure C-12. Cumulative release of Group 6 contaminants from upper-bound inventory sensitivity case.

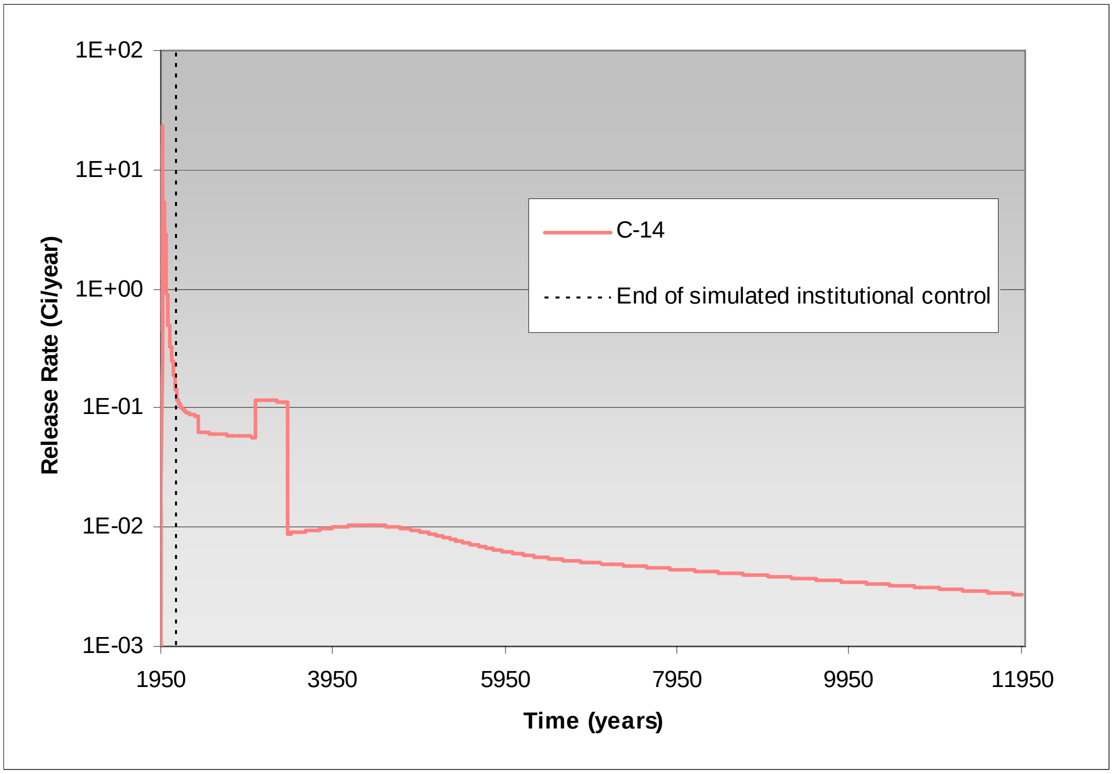


Figure C-13. Release of Group 8 contaminants from upper-bound inventory sensitivity case.

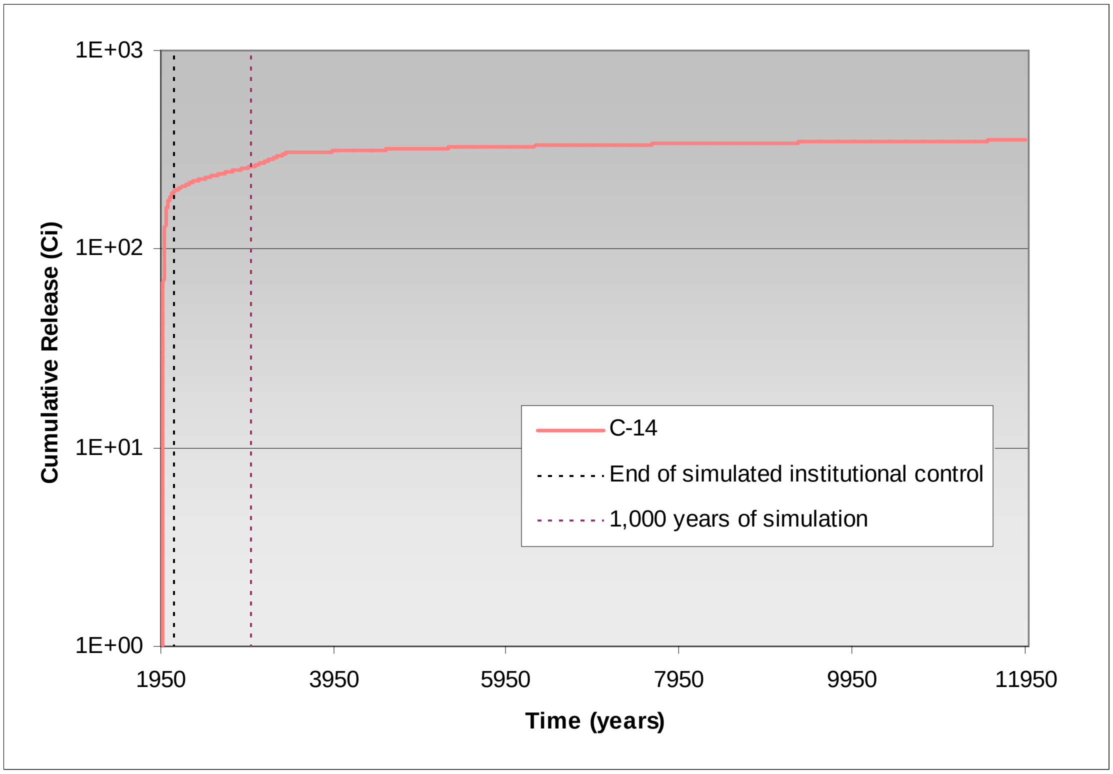


Figure C-14. Cumulative release of Group 8 contaminants from upper-bound inventory sensitivity case.

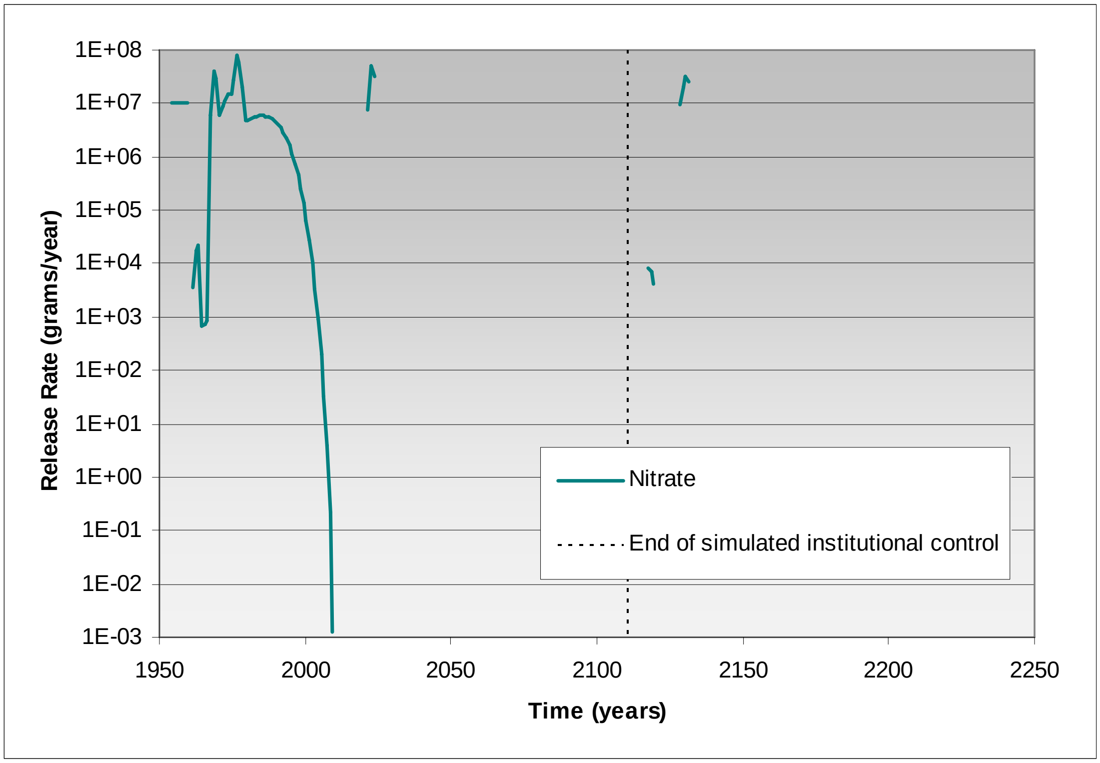


Figure C-15. Release of Group 10 contaminants from upper-bound inventory sensitivity case.

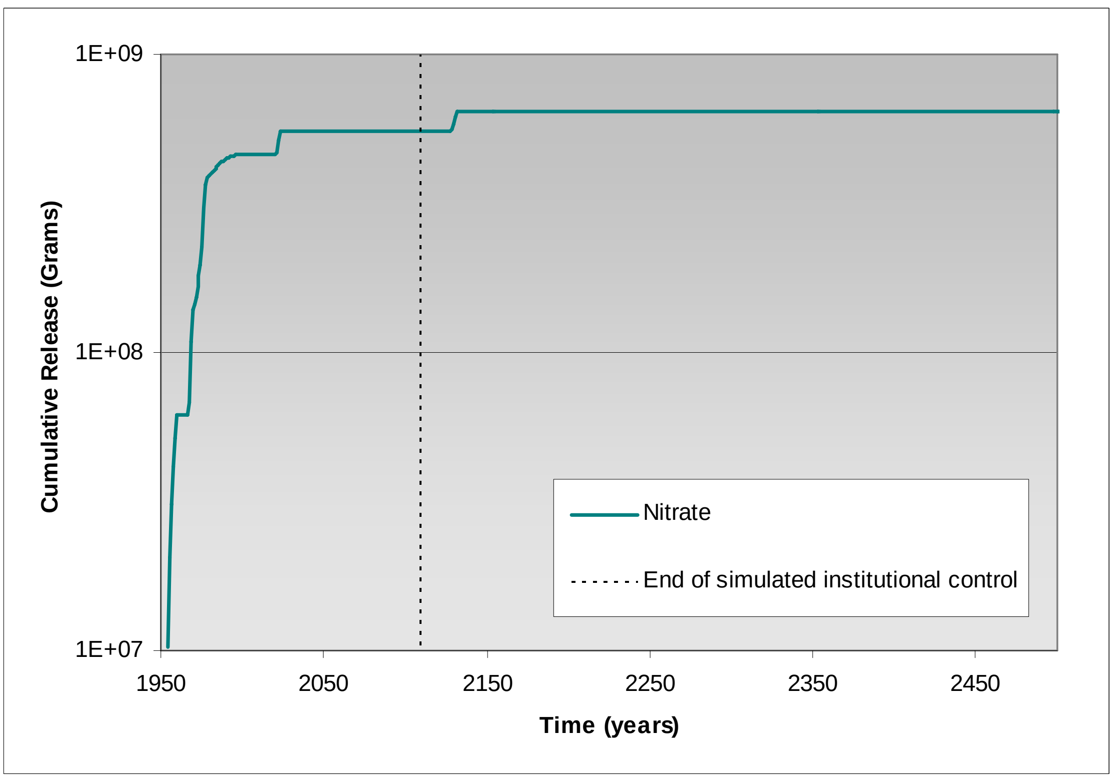


Figure C-16. Cumulative release of Group 10 contaminants from upper-bound inventory sensitivity case.

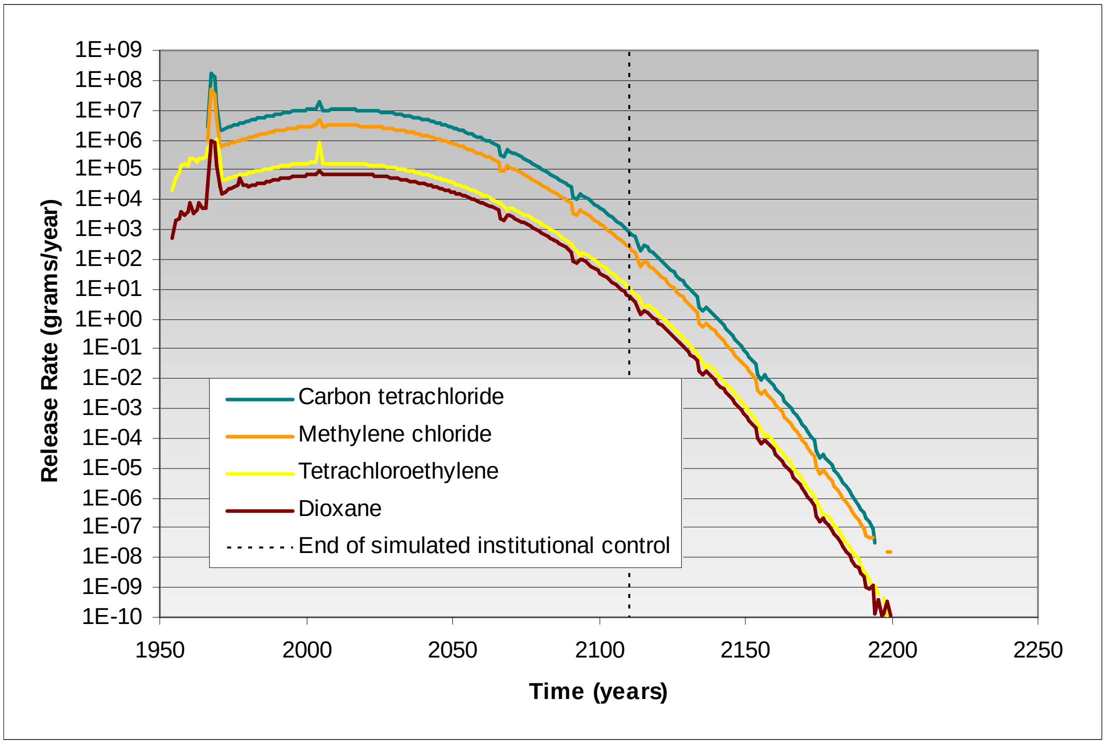


Figure C-17. Release of Group 11 contaminants from upper-bound inventory sensitivity case.

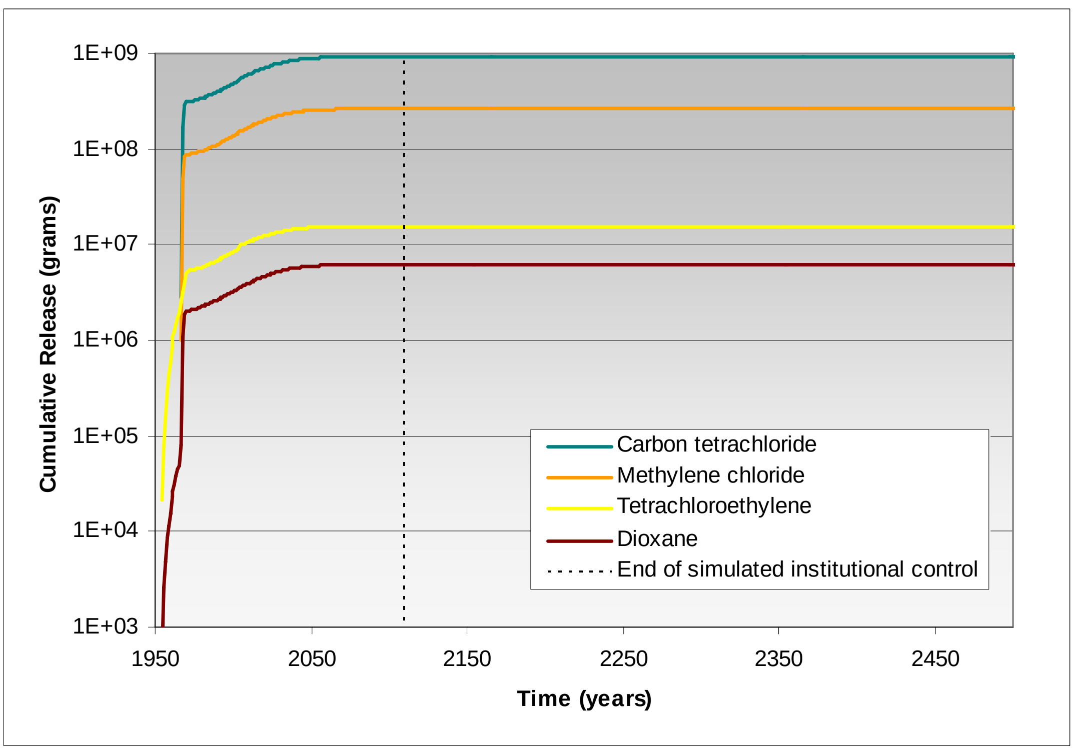


Figure C-18. Cumulative release of Group 11 contaminants from upper-bound inventory sensitivity case.

C-2. HIGH-INFILTRATION SENSITIVITY CASE RESULTS

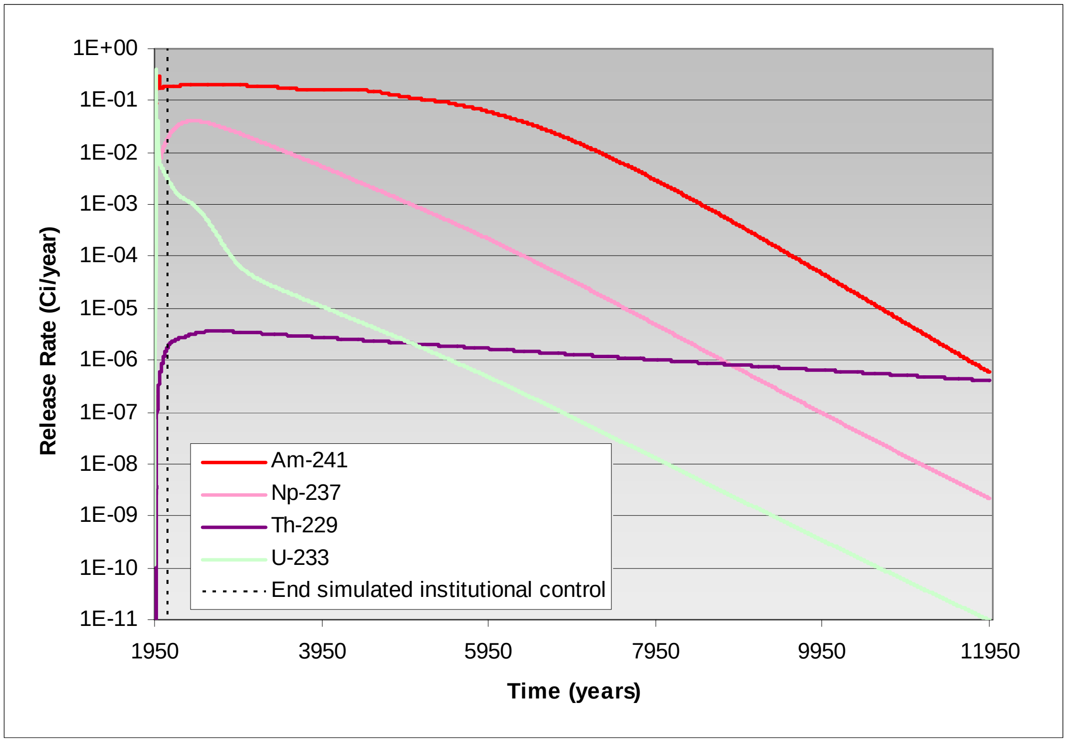


Figure C-19. Release of Group 1 contaminants for high-infiltration sensitivity case.

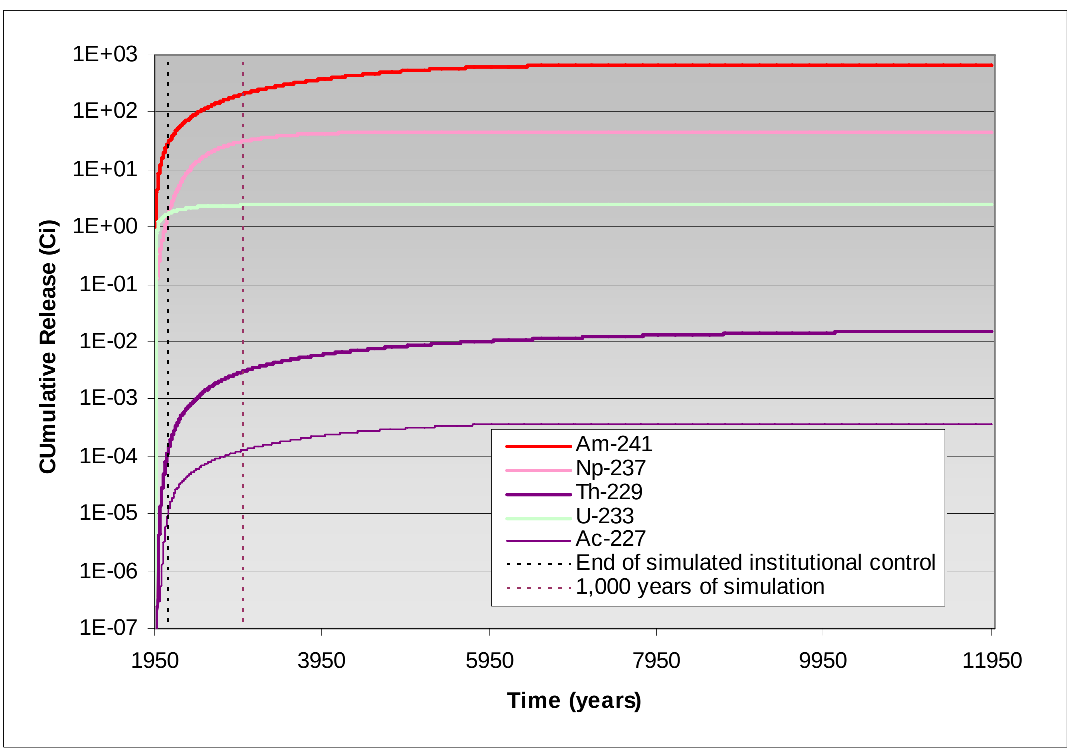


Figure C-20. Cumulative release of Group 1 contaminants for high-infiltration sensitivity case.

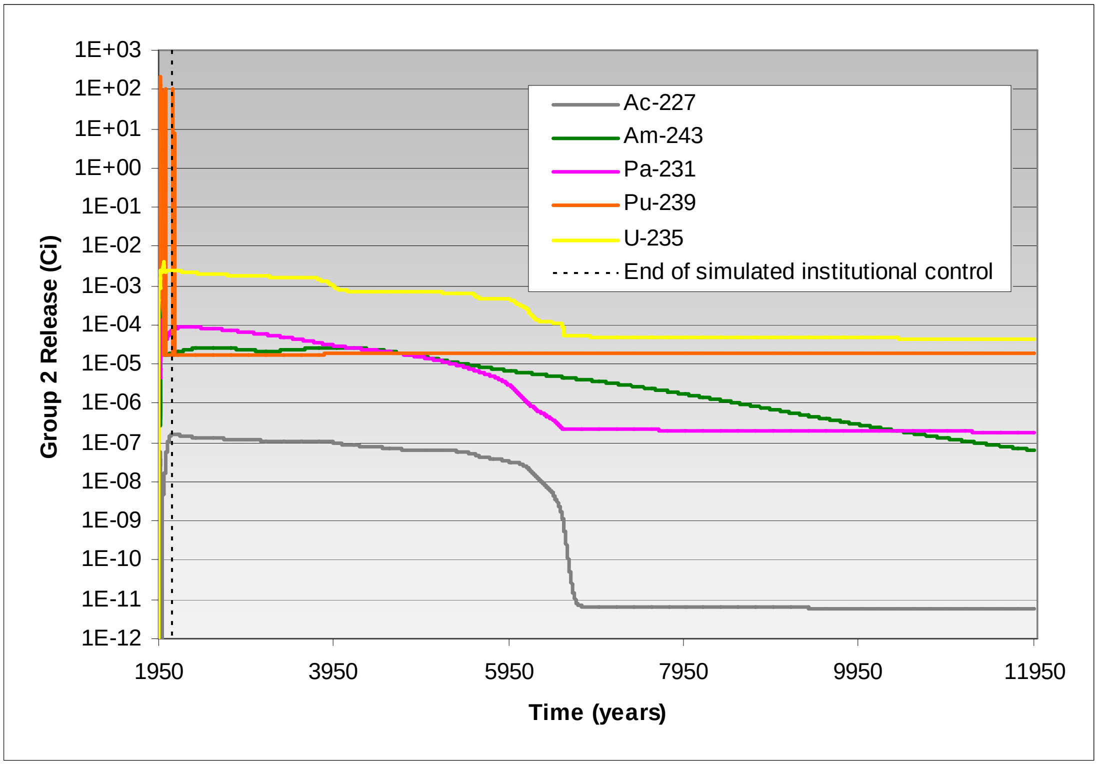


Figure C-21. Release of Group 2 contaminants for high-infiltration sensitivity case.

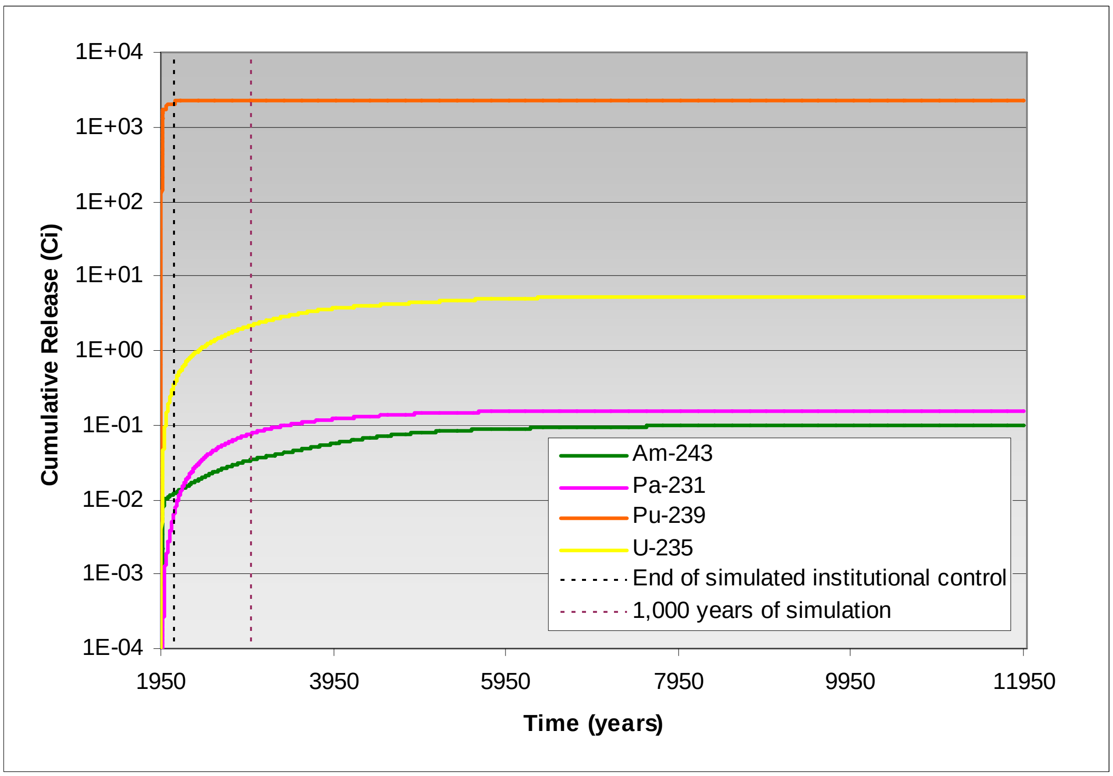


Figure C-22. Cumulative release of Group 2 contaminants for high-infiltration sensitivity case.

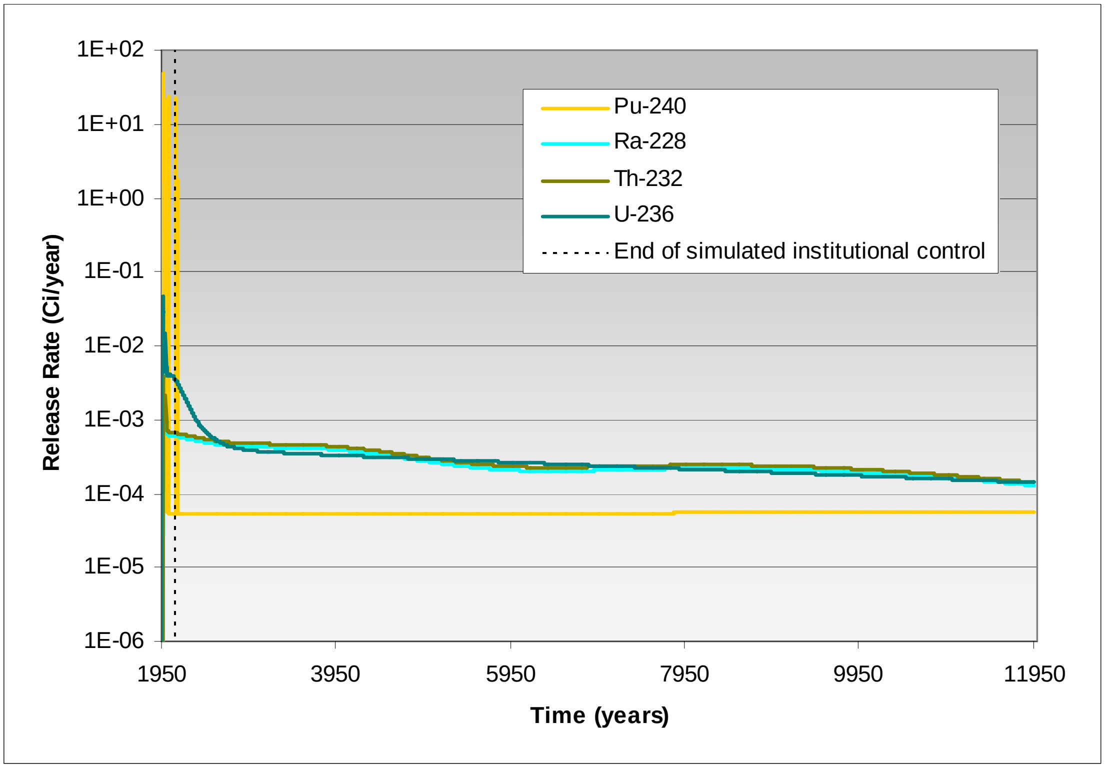


Figure C-23. Release of Group 3 contaminants for high-infiltration sensitivity case.

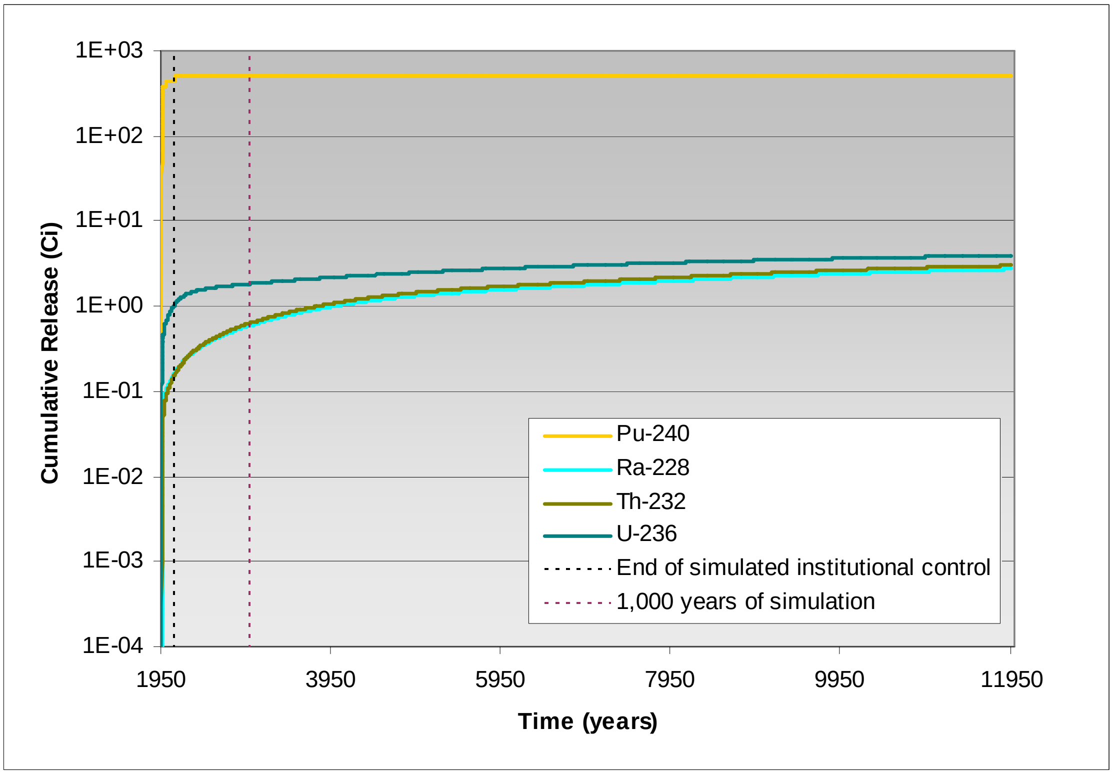


Figure C-24. Cumulative release of Group 3 contaminants for high-infiltration sensitivity case.

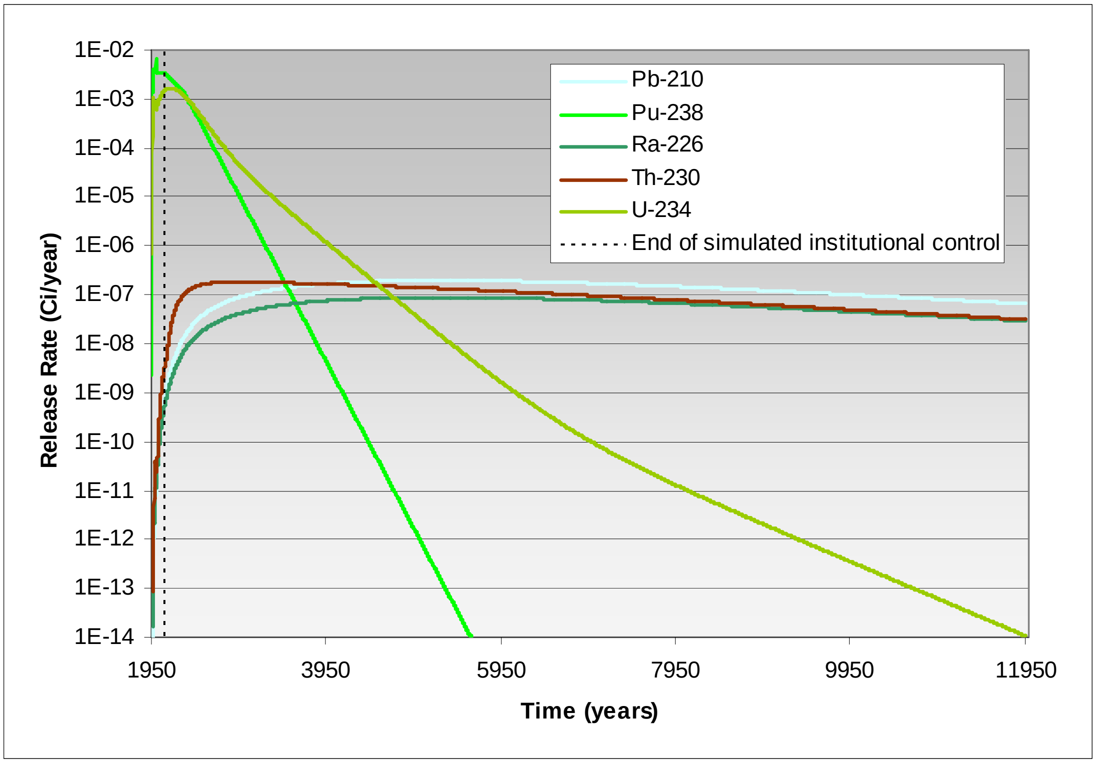


Figure C-25. Release of Group 4 contaminants for high-infiltration sensitivity case.

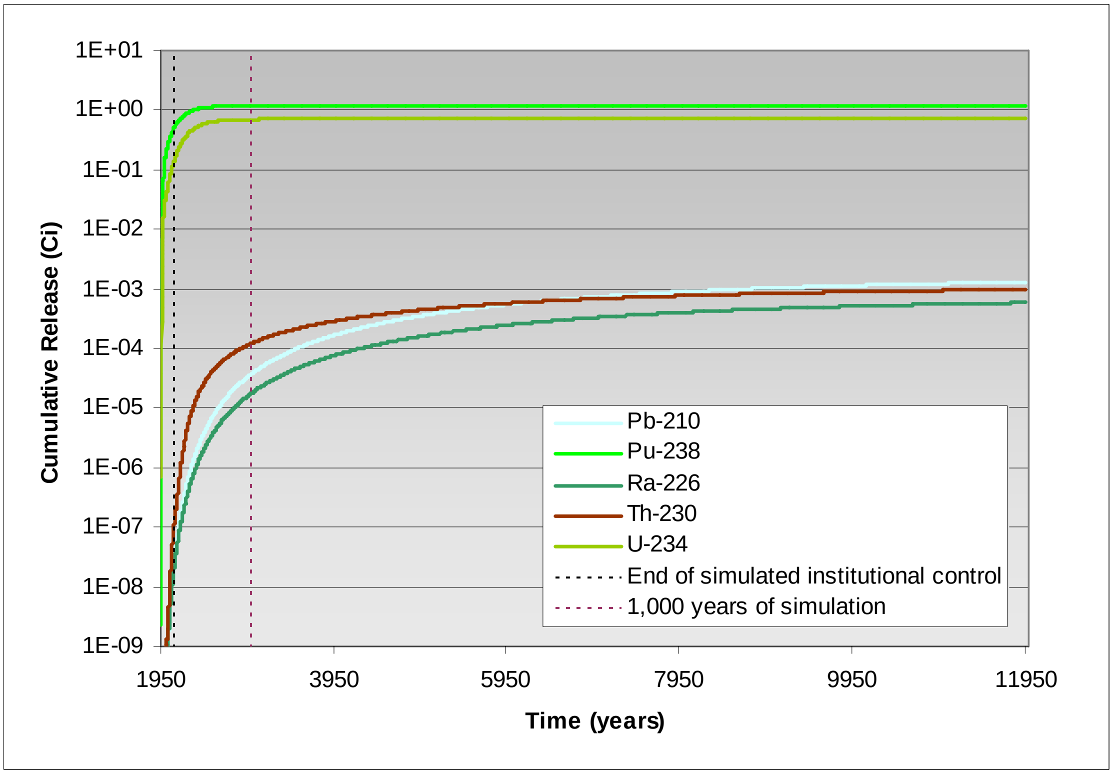


Figure C-26. Cumulative release of Group 4 contaminants for high-infiltration sensitivity case.

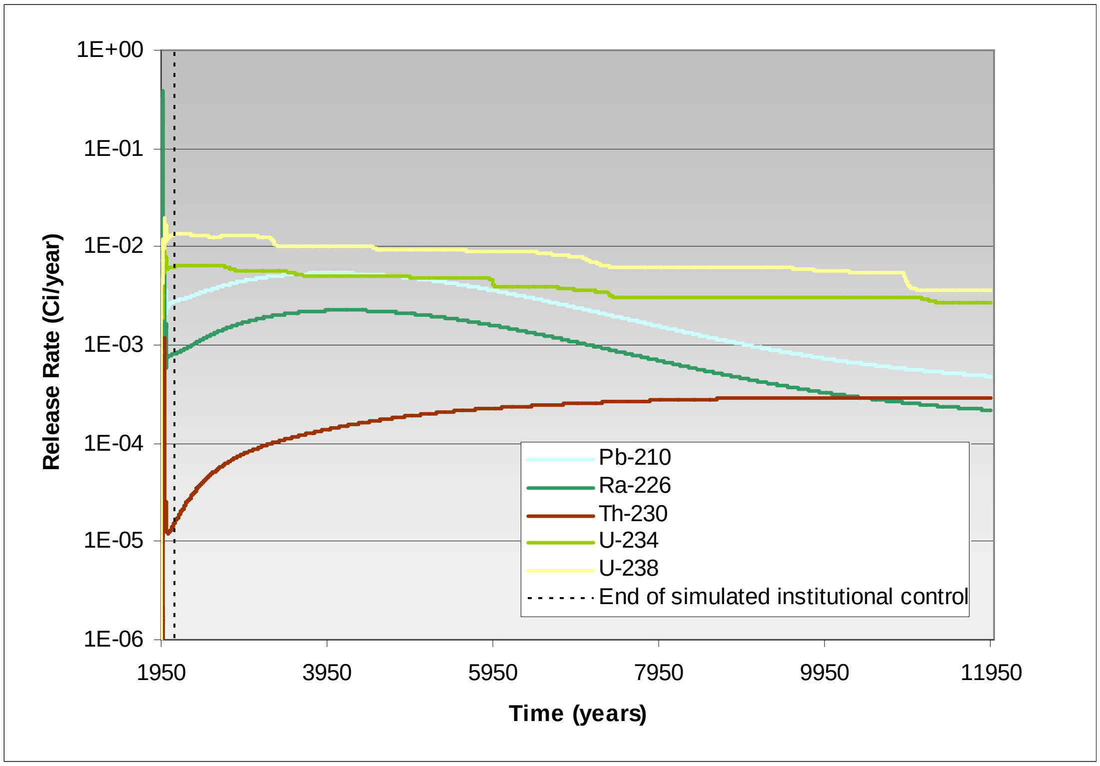


Figure C-27. Release of Group 5 contaminants for high-infiltration sensitivity case.

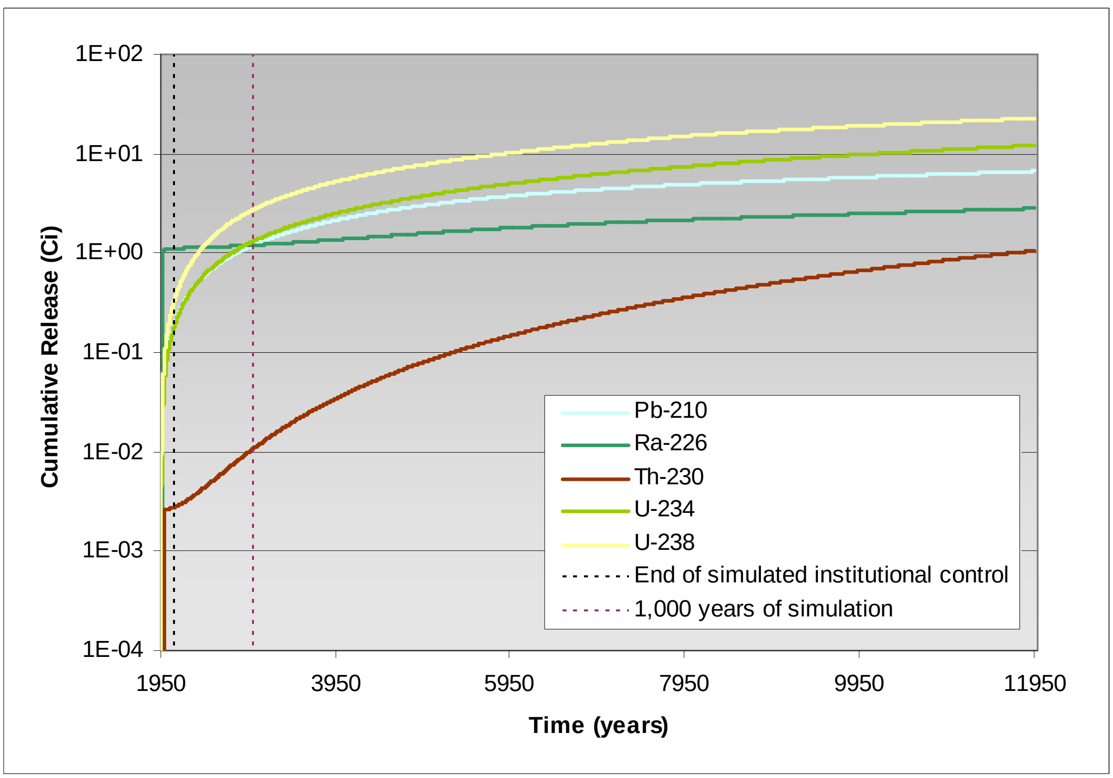


Figure C-28. Cumulative release of Group 5 contaminants for high-infiltration sensitivity case.

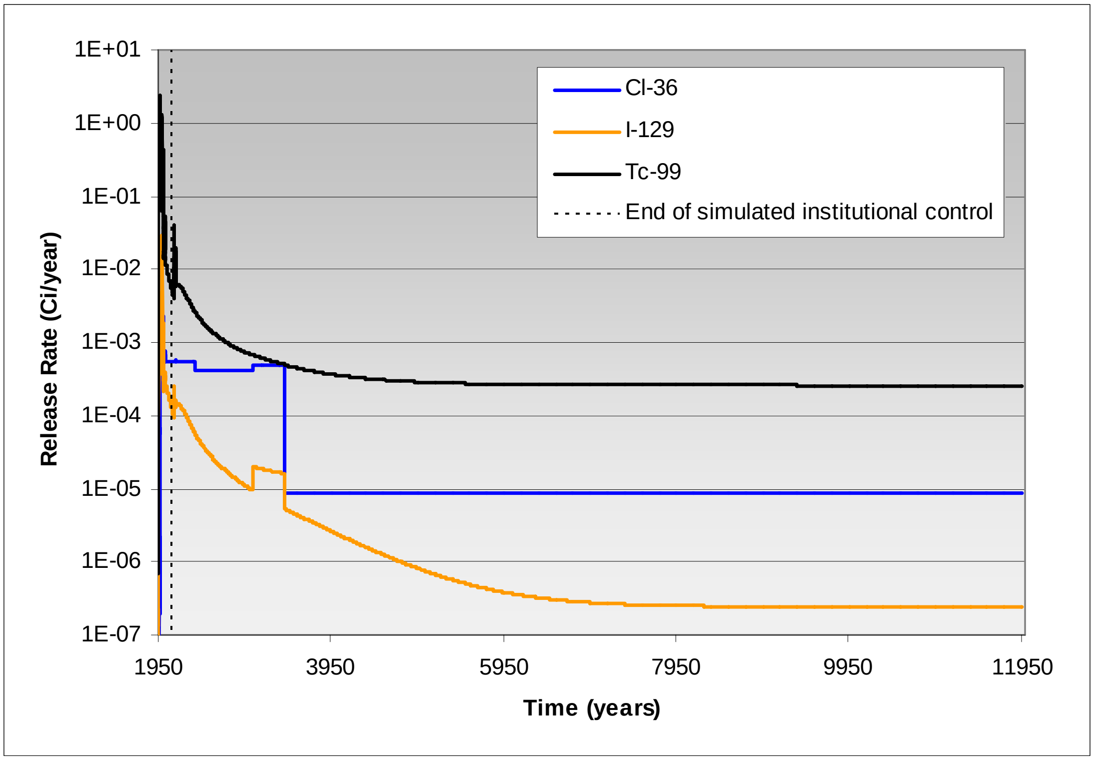


Figure C-29. Release of Group 6 contaminants for high-infiltration sensitivity case.

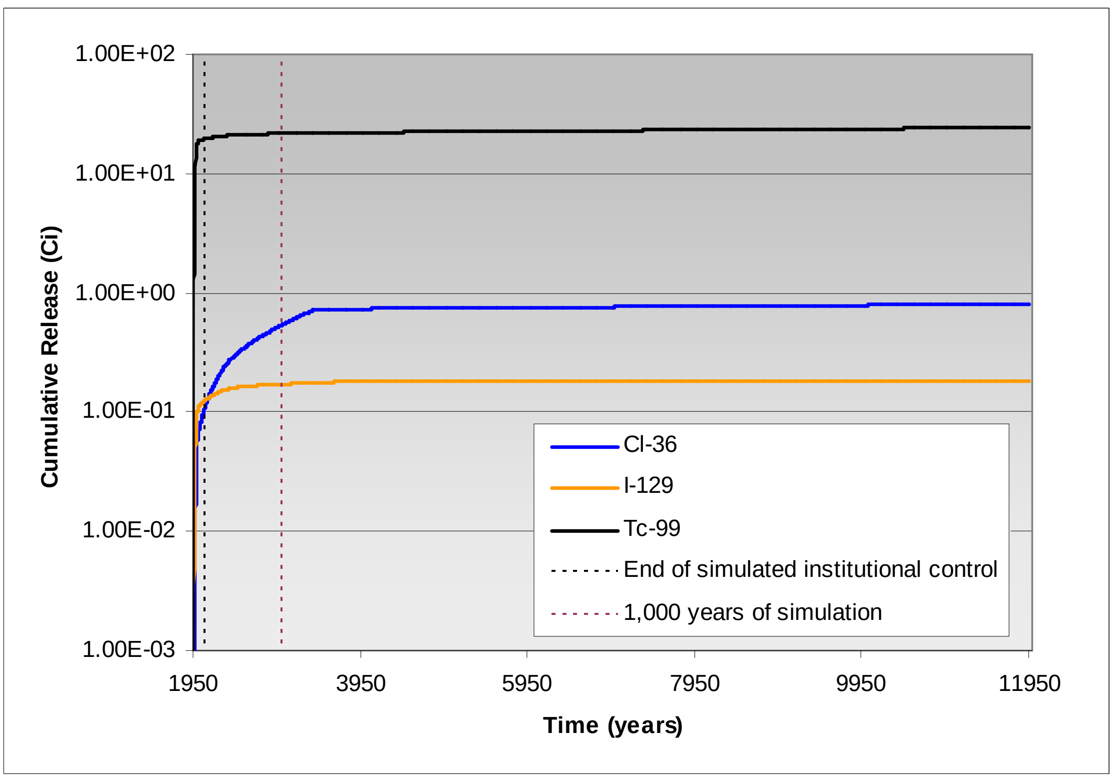


Figure C-30. Cumulative release of Group 6 contaminants for high-infiltration sensitivity case.

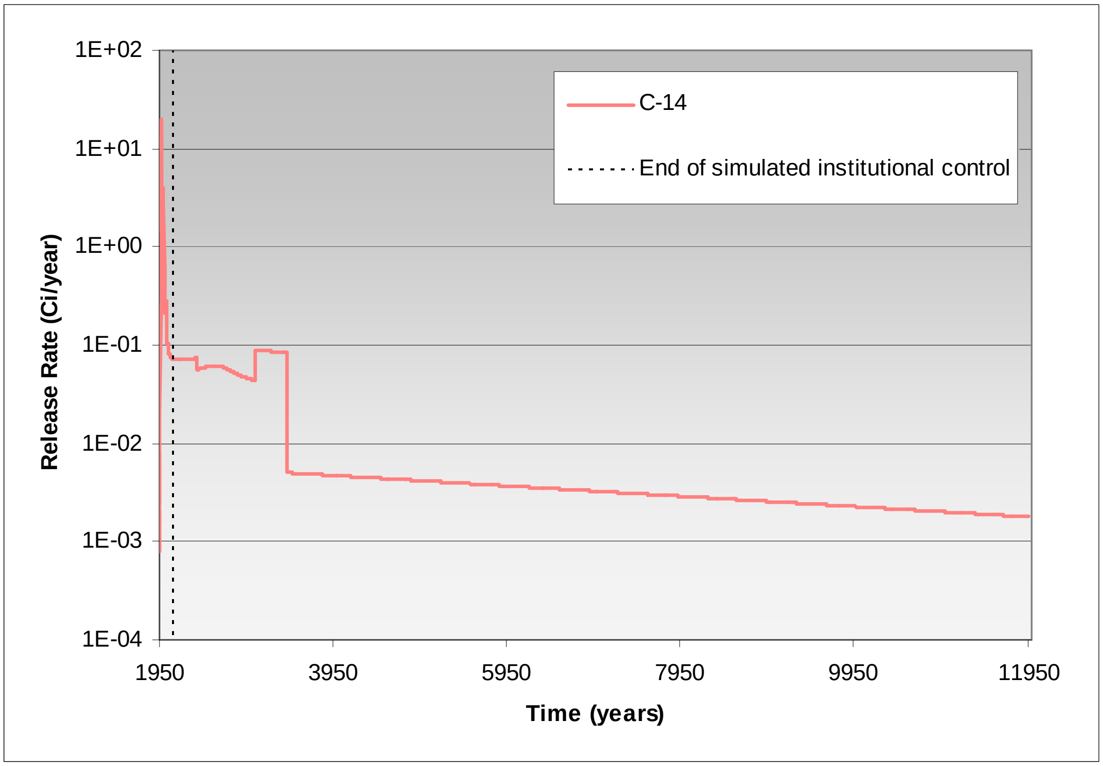


Figure C-31. Release of Group 8 contaminants for high-infiltration sensitivity case.

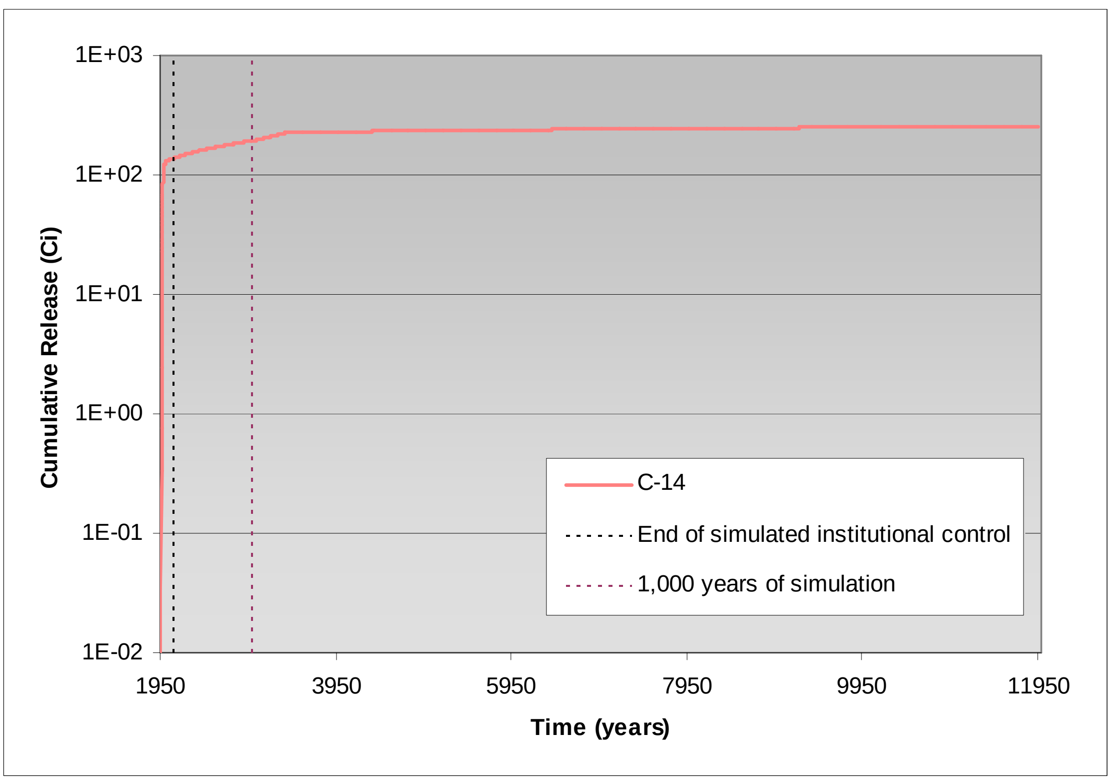


Figure C-32. Cumulative release of Group 8 contaminants for high-infiltration sensitivity case.

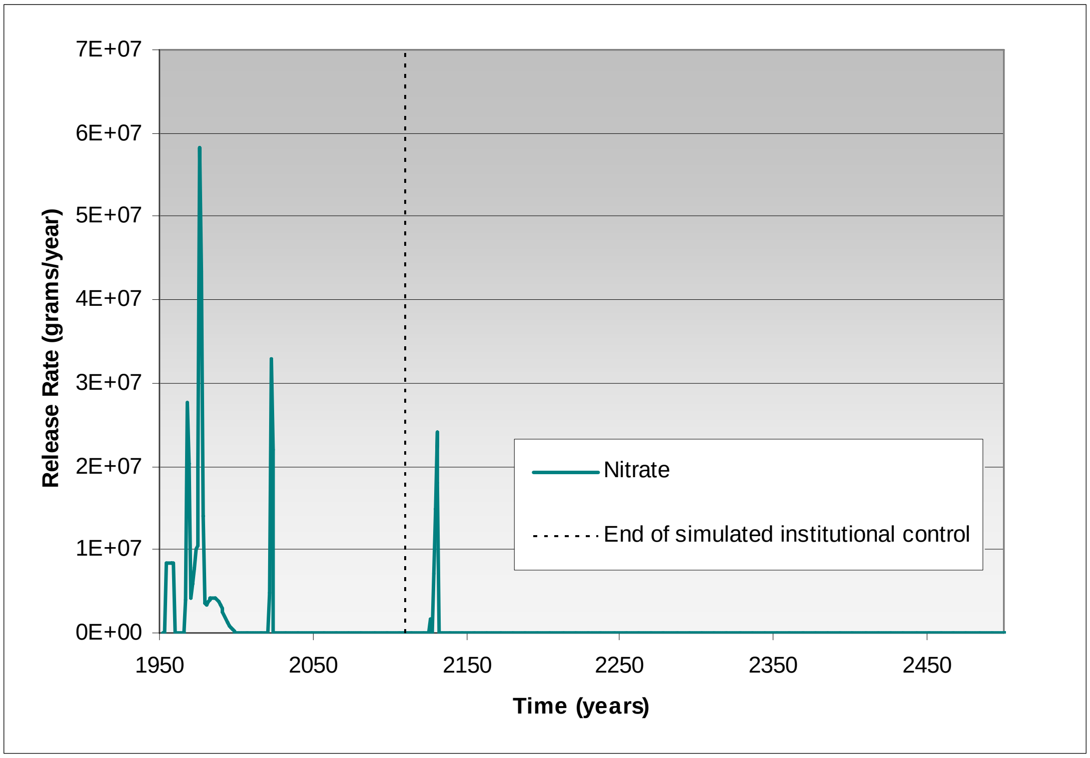


Figure C-33. Release of Group 10 contaminants for high-infiltration sensitivity case.

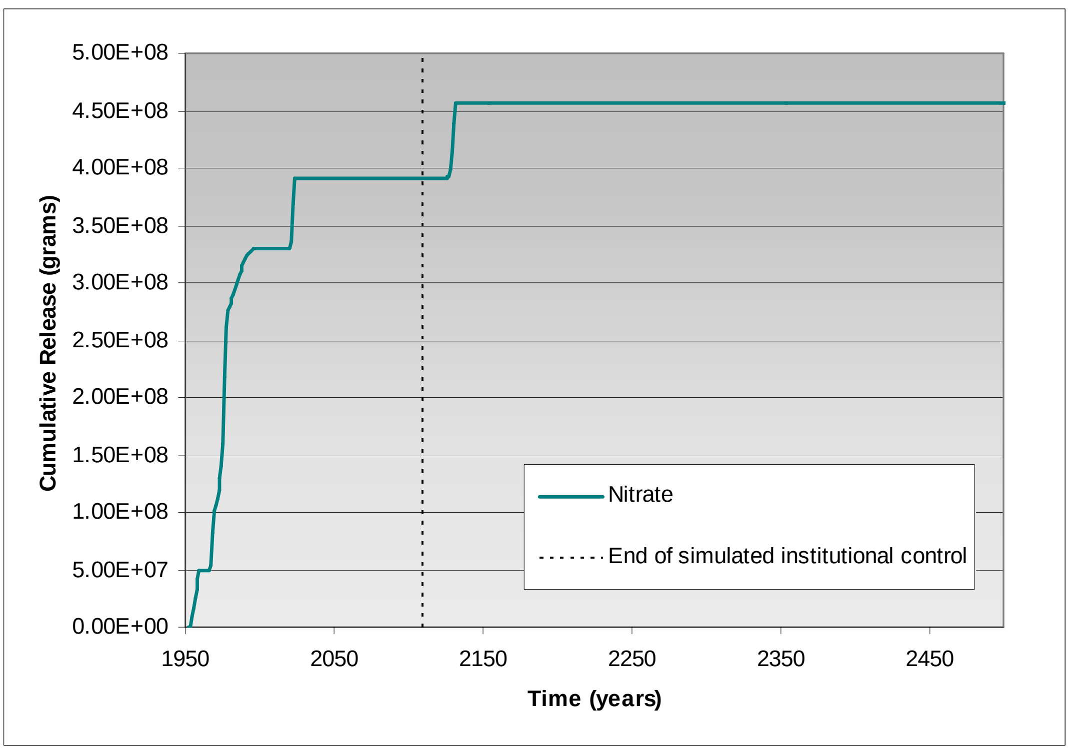


Figure C-34. Cumulative release of Group 10 contaminants for high-infiltration sensitivity case.

C-3. NO-RETRIEVAL AND NO GROUT SENSITIVITY CASE RESULTS

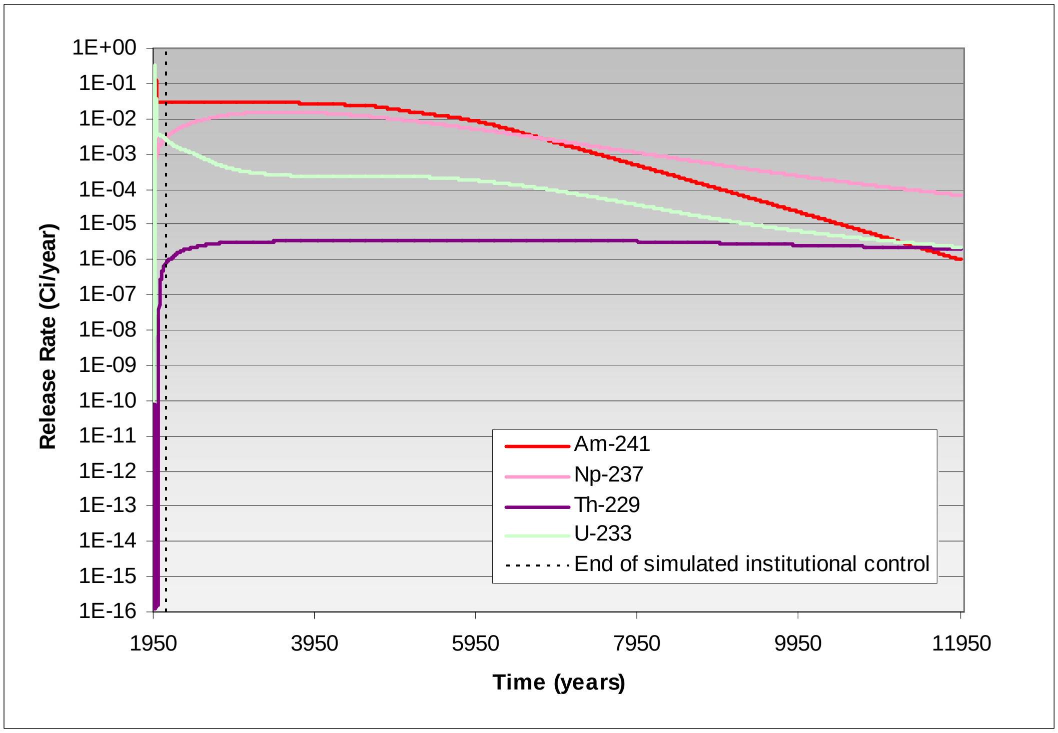


Figure C-35. Release of Group 1 contaminants for no-retrieval and no-grout sensitivity case.

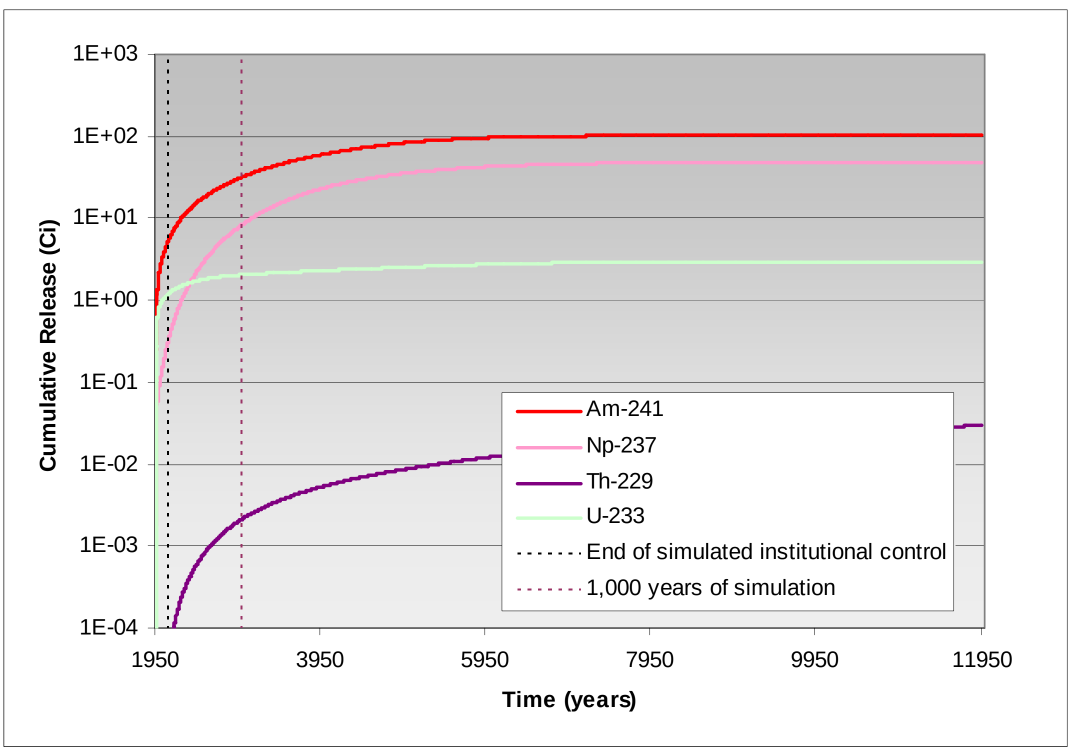


Figure C-36. Cumulative release of Group 1 contaminants for no-retrieval and no-grout sensitivity case.

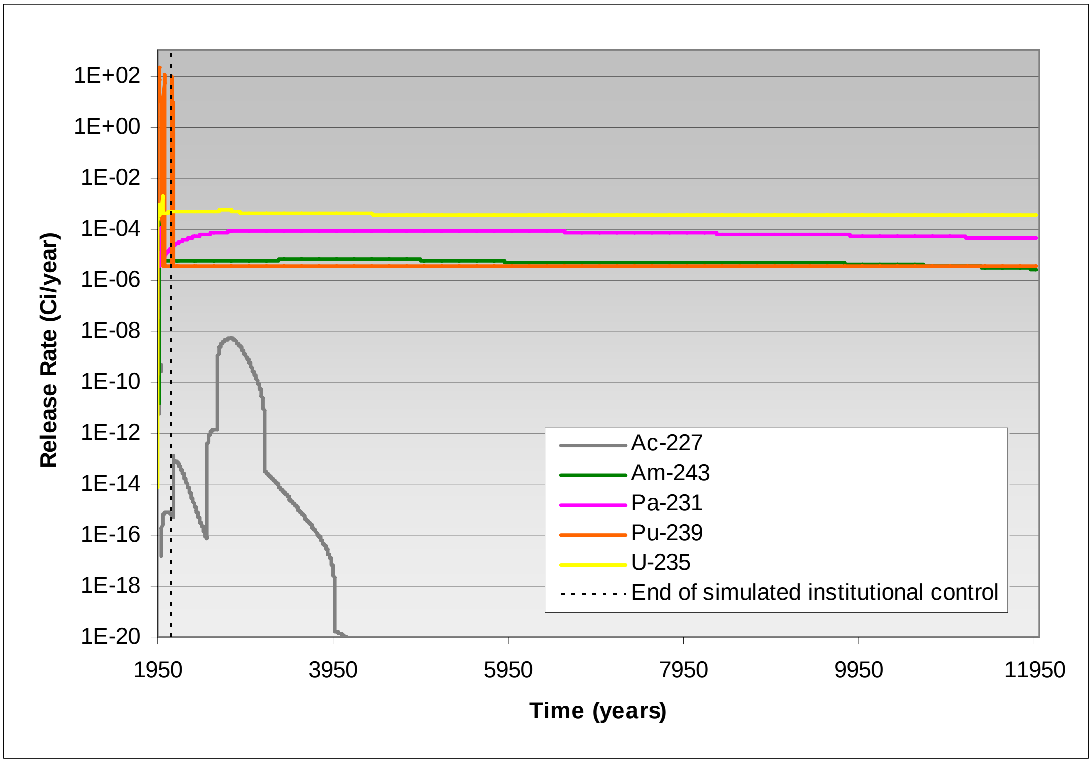


Figure C-37. Release of Group 2 contaminants for no-retrieval and no-grout sensitivity case.

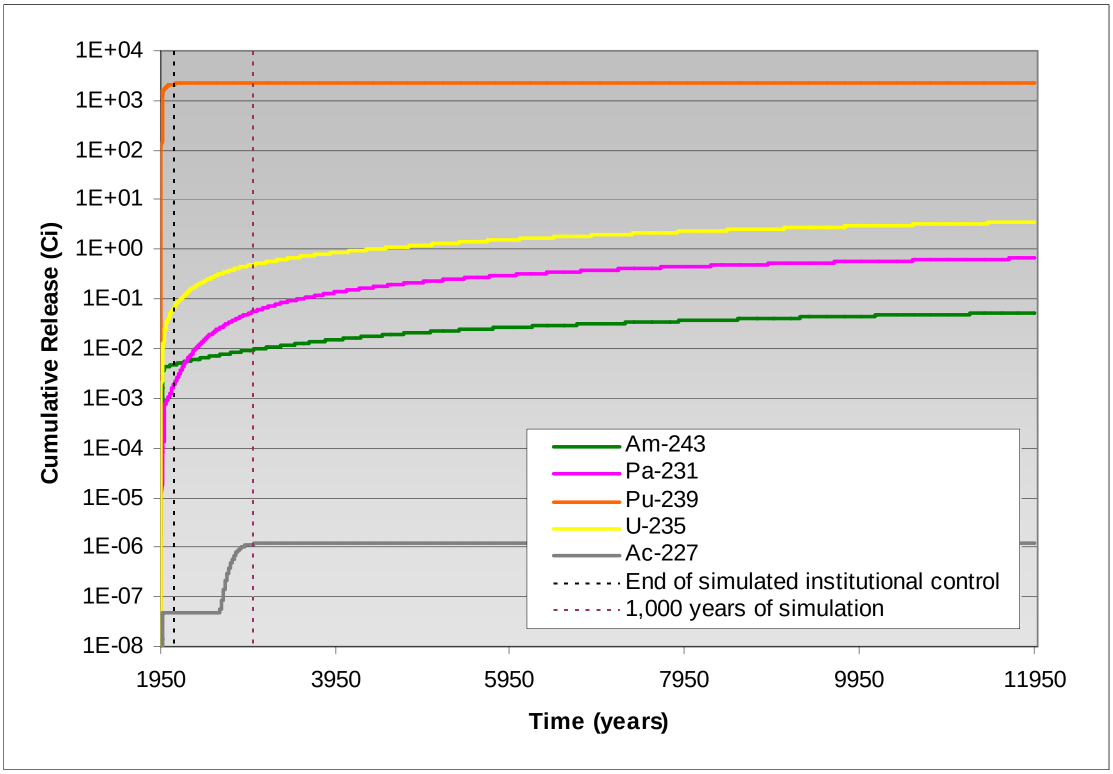


Figure C-38. Cumulative release of Group 2 contaminants for no-retrieval and no-grout sensitivity case.

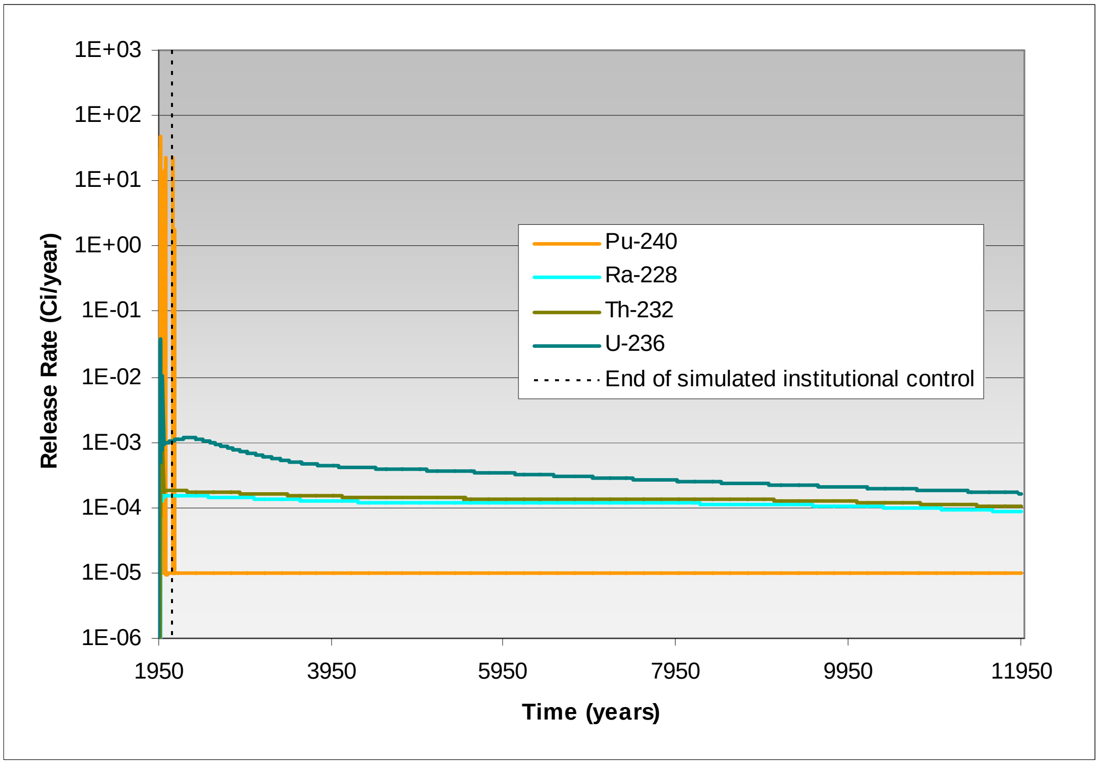


Figure C39. Release of Group 3 contaminants for no-retrieval and no-grout sensitivity case.

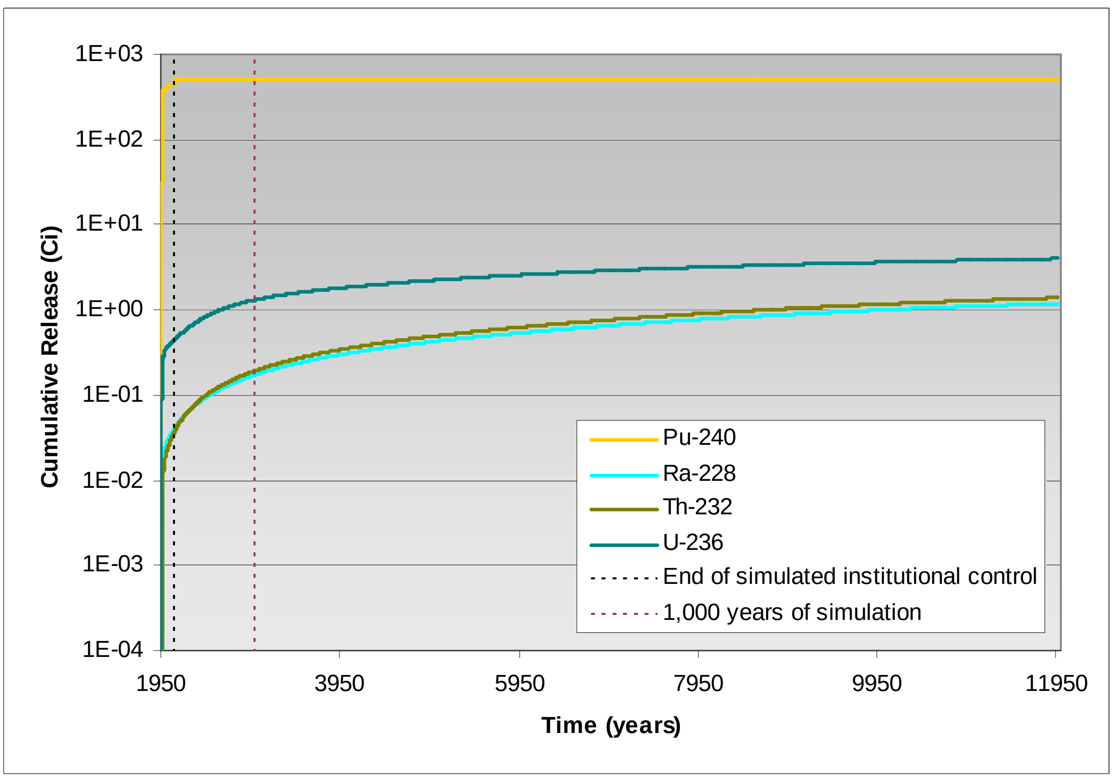


Figure C-40. Cumulative release of Group 3 contaminants for no-retrieval and no-grout sensitivity case.

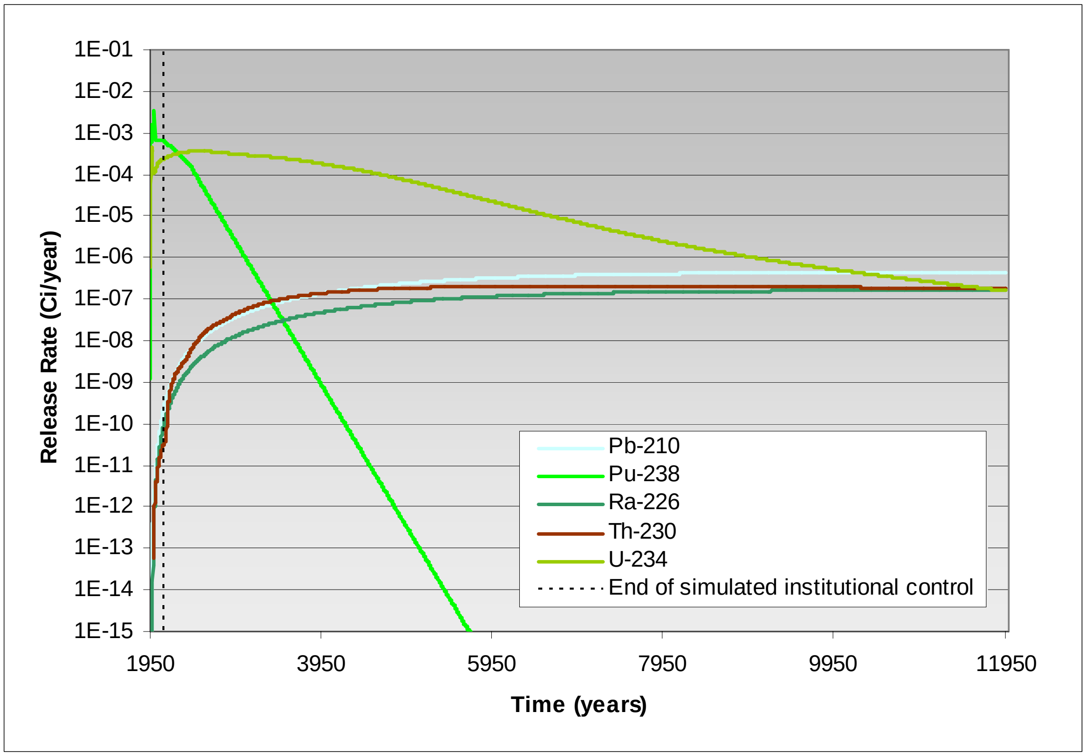


Figure C-41. Release of Group 4 contaminants for no-retrieval and no-grout sensitivity case.

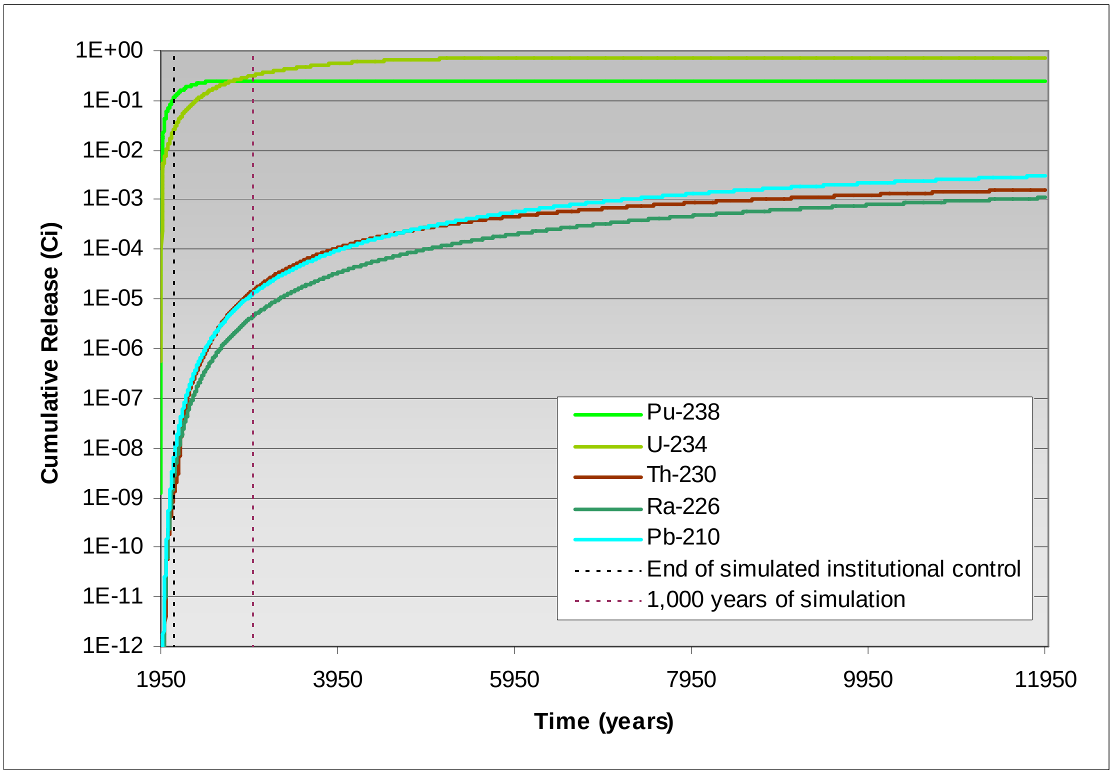


Figure C42. Cumulative release of Group 4 contaminants for no-retrieval and no-grout sensitivity case.

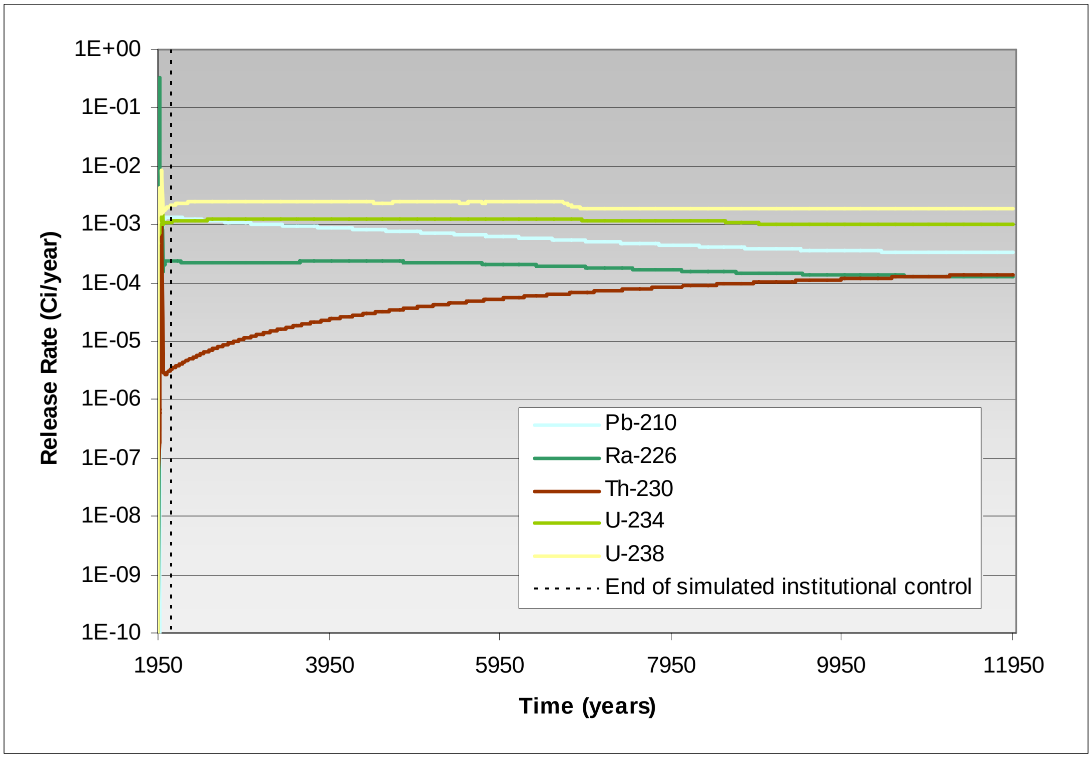


Figure C-43. Release of Group 5 contaminants for no-retrieval and no-grout sensitivity case.

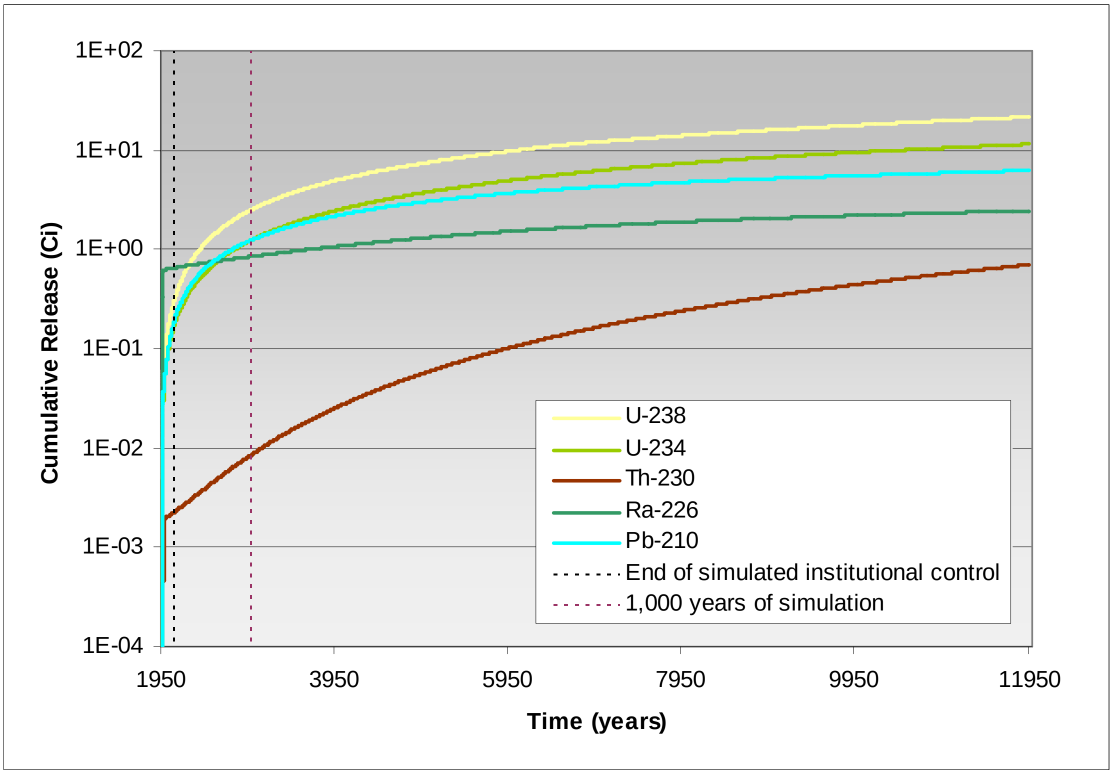


Figure C-44. Cumulative release of Group 5 contaminants for no-retrieval and no-grout sensitivity case.

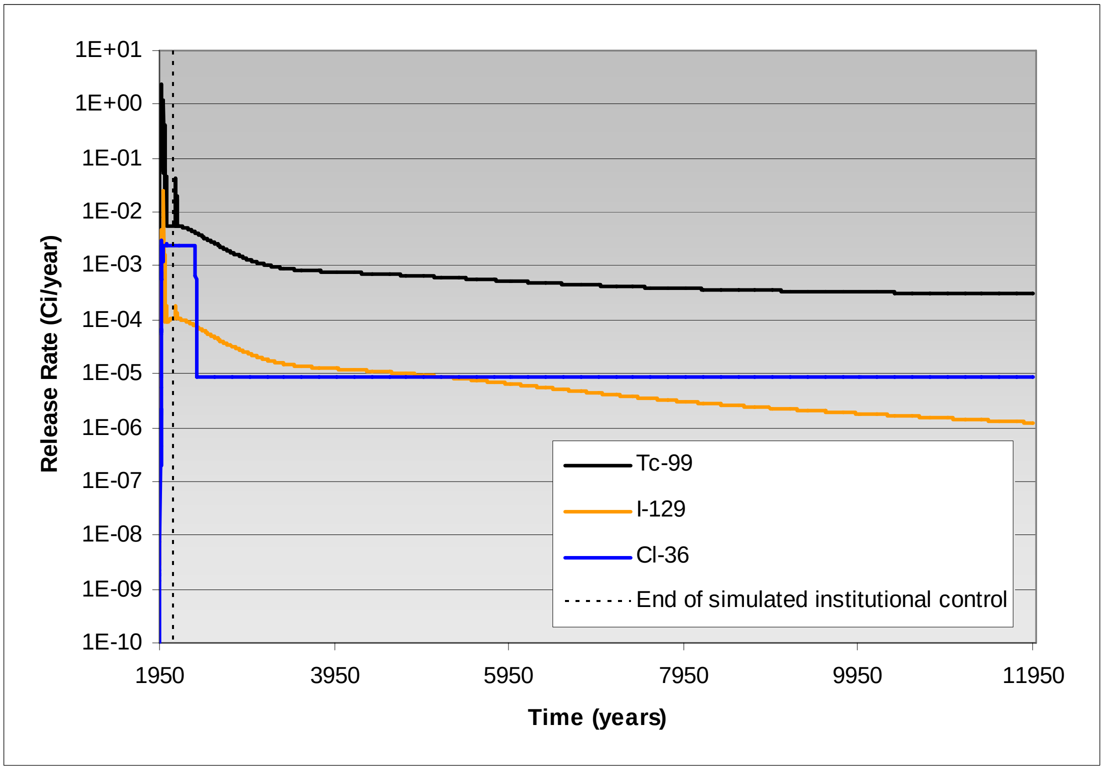


Figure C-45. Release of Group 6 contaminants for no-retrieval and no-grout sensitivity case.

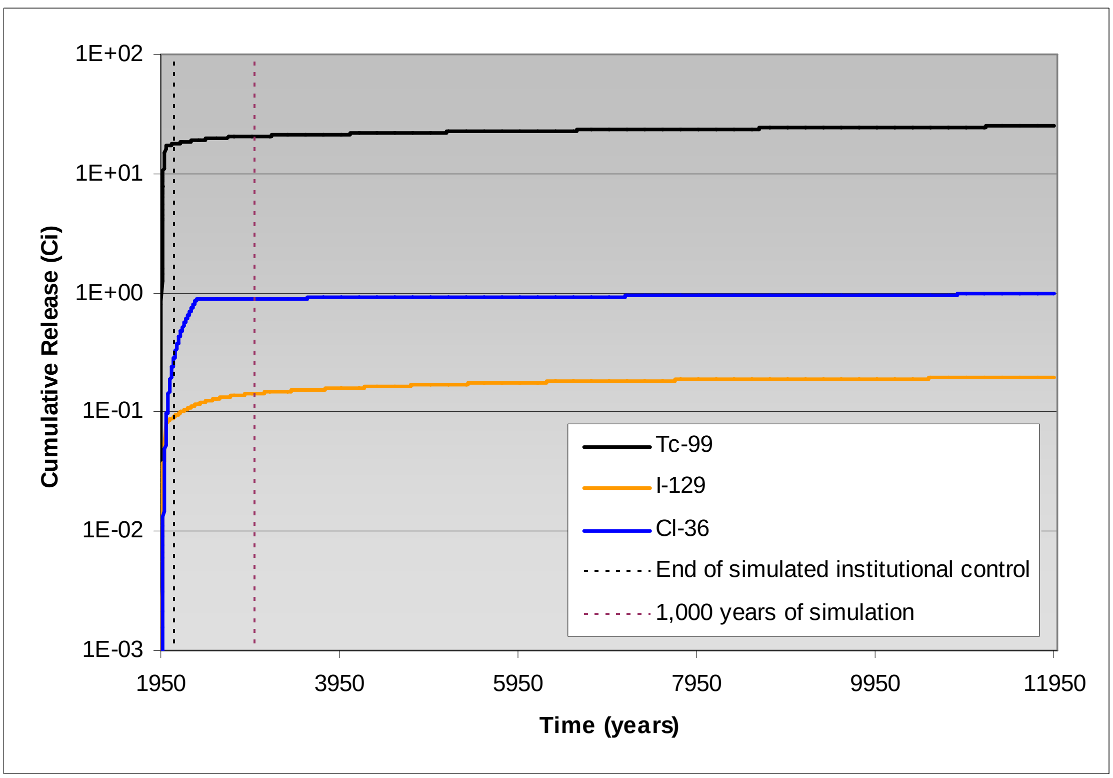


Figure C-46. Cumulative release of Group 6 contaminants for no-retrieval and no-grout sensitivity case.

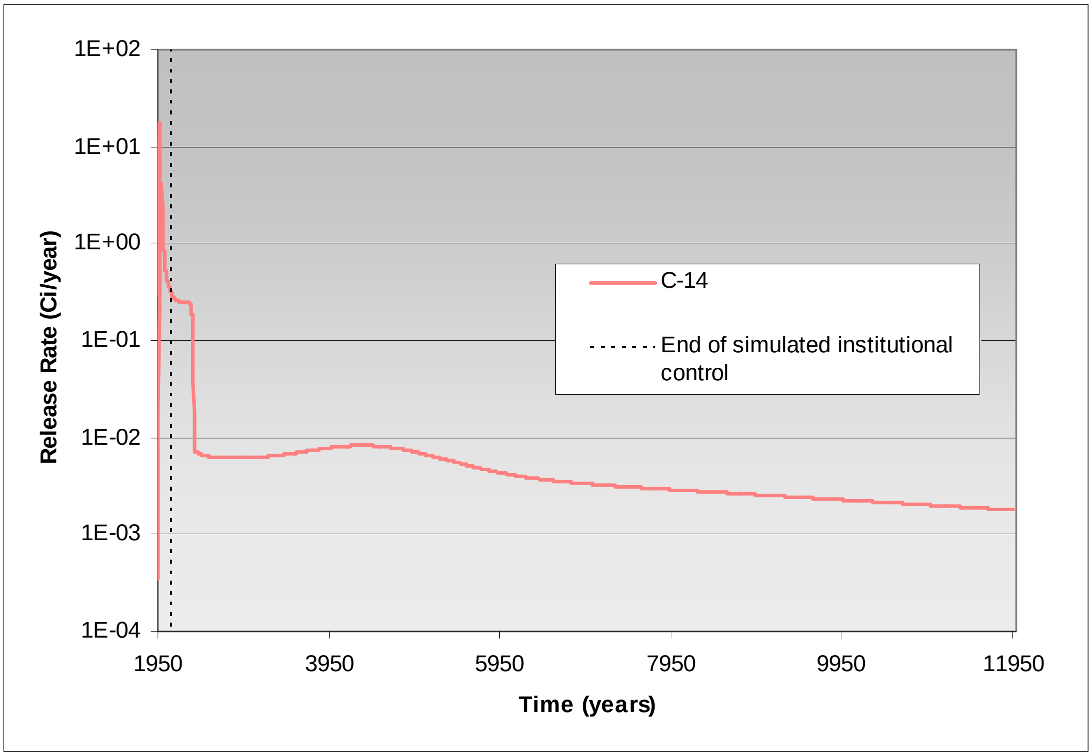


Figure C-47. Release of Group 8 contaminants for no-retrieval and no-grout sensitivity case.

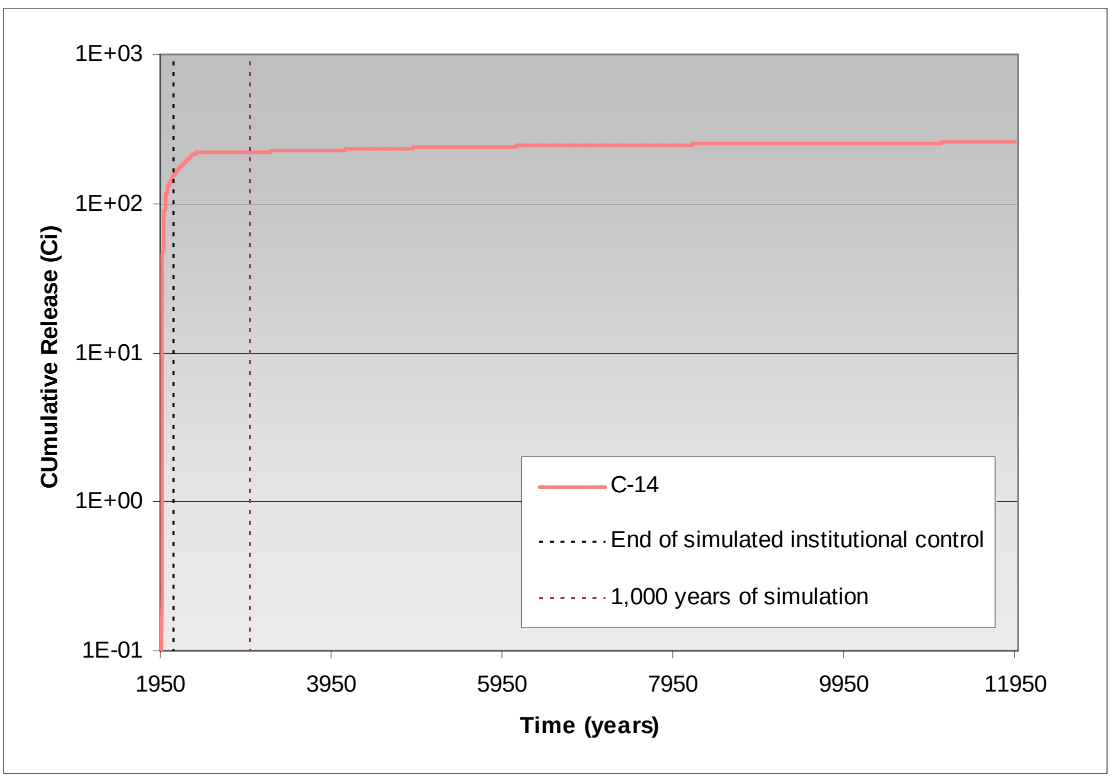


Figure C-48. Cumulative release of Group 8 contaminants for no-retrieval and no-grout sensitivity case.

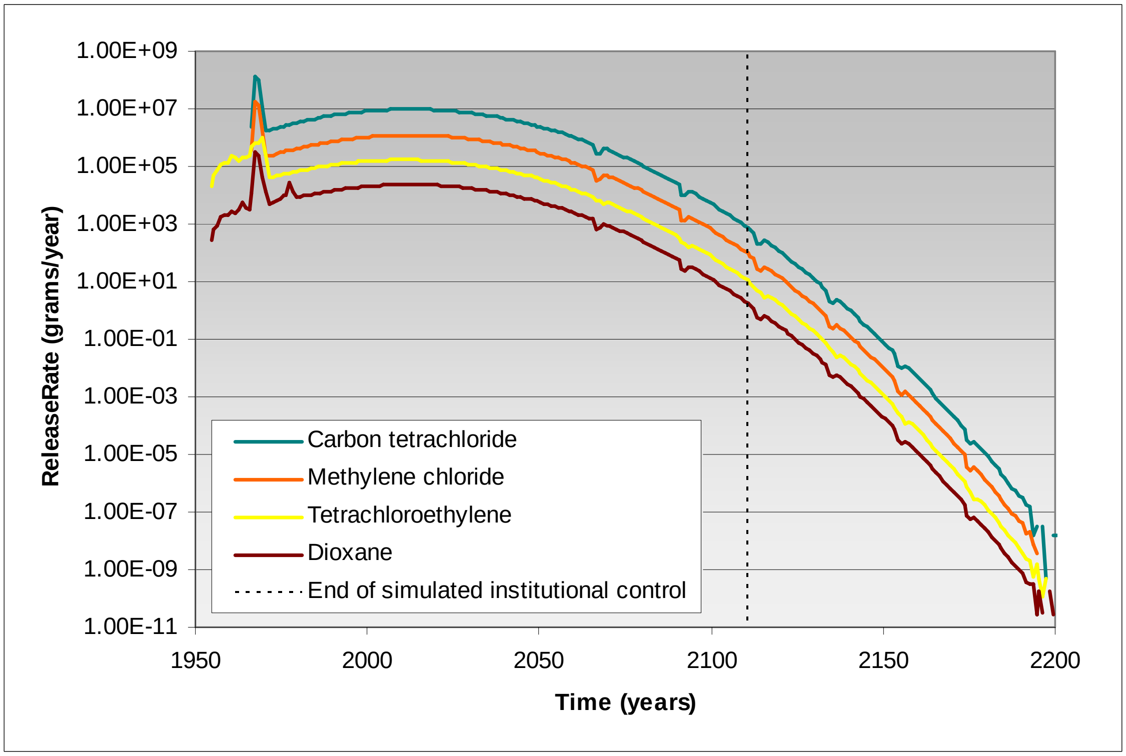


Figure C-49. Release of Group 11 contaminants for no-retrieval and no-grout sensitivity case.

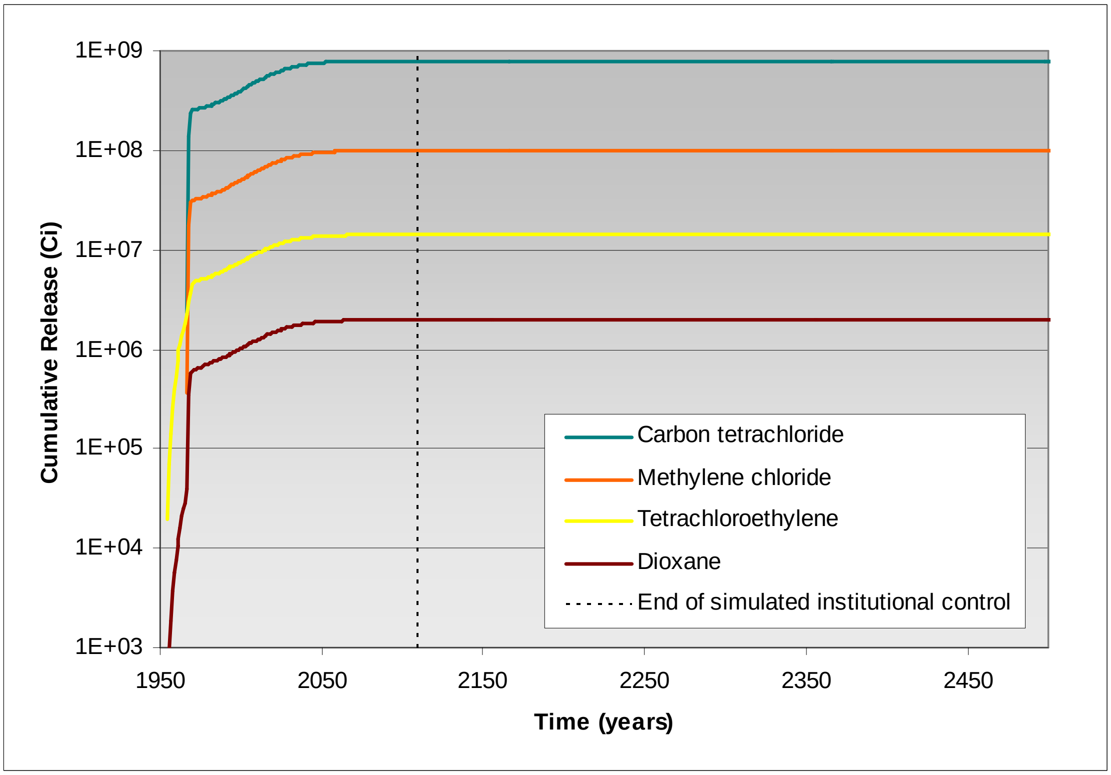


Figure C-50. Cumulative release of Group 11 contaminants for no-retrieval and no-grout sensitivity case.

Appendix D

Development of Container-failure Distributions for Technetium-99 and Iodine-129

Appendix D

Development of Container-failure Distributions for Technetium-99 and Iodine-129

This appendix provides additional details regarding the process used to estimate and assign failure distribution modes and parameters to waste shipments containing Tc-99 and I-129. The resulting assignment of waste inventory to a particular failure distribution is shown in the main body of this report and is not repeated here.

Eleven waste packagings, which could provide a barrier to prevent the migration of Tc-99 and I-129, were identified. These packagings were categorized into one of two types: metal and plastic/polyethylene (poly). The breach times were then based on one of two factors: (1) The corrosion rate for metal or (2) the absorbed dose on poly. Application of the processes causing eventual failure was applied in a conservative manner.

Failure of Metal Containers

Corrosion rates of metal were obtained from Table 5-4 of the Ancillary Basis for Risk Analysis (ABRA) (Holdren et al. 2002). In this table, corrosion rates were established as a 1-mm penetration over a period of time. The following method was used to apply this corrosion rate to a particular container type:

1. Establish the container wall thickness in millimeters and divide by 2.
2. Multiply the thickness value by the corrosion rate.

The resultant calculation gives an early but reasonable failure date for the container type. This analysis is summarized in Table D-1. The table describes each container type that was evaluated and the analysis performed.

Table D-1. All container types.

Container Code	Container Description	Time-to-Breach Analysis
bal	Compacted waste. Waste was first placed in a poly bag, then compacted into a cardboard box, which was poly wrapped before disposal.	Initially a zero time to breach was assigned, based on the packaging, no sealed closure, and the rough method of handling during disposal.
basket	Carbon steel open-top container that has drain holes in the bottom, used for underwater, i.e., water pit/canal waste operations; gross volume ~ 28 ft^3.	Resistance to Tc-99 migration is inherent to the waste material, which is core structural in nature. Also includes intact fuel bundles. These factors provide at least 4,500 years protection.
blm	Pre-1975 nonspecification metal drums/barrels of various sizes, usually with some type of liner. Wall thickness is uncontrolled.	No quality control existed for these drums. Frequently they were second-time-use containers. This type of drum is allowed "zero" years to breach.

Table D-1. (continued).

Container Code	Container Description	Time-to-Breach Analysis
blm-55	1975 and later procured DOT specification 55-gal drums, nominal 18-gauge wall, painted, with a minimum 6-mil poly liner. “Criteria for Packaging Solid Radioactive Waste for Receipt at the Radioactive Waste Management Complex: INEL-Generated Waste” (WMP 77-13) The original issued document is missing, but the writer of this statement was the author of both.	Nominal 18-gauge wall, 1.25 mm (0.5 in.), painted, usually with some type of liner. Conservatively using 1/2 the thickness or 0.625 mm × 450 years = 280 years to breach. No allowance for liner, same conditions of breach as described for wooden boxes.
bot	Bottles of any material, usually heavy wall plastic/poly or glass.	Considering heavy sidewalls and the inherent design to contain materials, these are considered to provide 1,000 years containment.
bxc/poly	Cardboard box with a poly bag liner or individually bagged or wrapped items	Failure sufficient to allow water transport of Tc-99 has been calculated from a radiation-based embrittlerment study providing an exposure time to achieve 10^8 rem absorbed dose, point of failure, divided by 100 for conservatism. Due to the protective factor provided by the outer container, mechanical failure of the package was not considered.
bxm	Metal box of painted carbon steel	Nominal 12-gauge wall, 2.75 mm (1.083 in.), painted, usually with some type of liner. Conservatively using 1/2 the thickness or 1.375 mm × 450 years = 618 years to breach. No allowance for liner, same conditions of breach as described for wooden boxes.
bxw	Wooden box, usually made of exterior grade plywood, painted with fire-retardant paint and lined with poly or contained individually poly-wrapped items, nailed and glued lid and banded. Numerous sizes were received.	Placement of waste into wooden boxes is not a delicate process and normally initiates voids in the poly packaging and liner. If the loading process does not initiate breach, transportation probably will; therefore, a time factor of “zero” assigned.

Table D-1. (continued).

Container Code	Container Description	Time-to-Breach Analysis
can	Similar to a paint can, with a plastic liner and usually dry loaded	Estimated the can to be of carbon steel and 1/2 mm (0.02 in.) in thickness. Conservatively using 1/2 the thickness or 1/4 mm × 450 years = 112 years to breach failure. Transport of Tc-99 from the poly liner has been calculated from a radiation-based embrittlerment study, providing an exposure time to achieve 10^8 rem absorbed dose, point of failure, divided by 100 for conservatism. Due to the protective factor provided by the can, mechanical failure of the package was not considered.
capsule	A small heavy wall container utilized in a specific experiment loop, usually made of either aluminum or stainless steel.	These items are normally constructed of very corrosion-resistant material and have heavy cross section that will provide a minimum of 4,500 years containment.
cask	Normally, stainless steel shells with lead shielding and a payload cavity, reusable in nature. When so noted, the cask was disposed of, usually with an insert.	Contents of the cask therefore are isolated from soil chemistry and from physical breaching and are estimated to provide a minimum of 1,000 years until breach.
cppsc	Chemical Processing Plant sludge cask is a 76-ft^3 tank encased in ~ 2 ft of concrete, all sides, gross volume is 478 ft^3 @ 47,500 lb.	Method of construction and closure of penetration(s) provide, based on the thickness of the penetration sidewall (pipe cap), a minimum of 1,000 years containment.
csbx	Carbon steel box. Waste Calcining Facility filter insert approximately 20 ft^3 each, walls and bottom are 0.25 in. thick (6.25 mm), top is 0.5 in. thick. Leak-tight construction.	Table 5-4 Summary of release types and release rate coefficients… (Holdren et al. 2002) allows 450 to 680 years corrosion per mm of steel. Conservatively using 1/2 the thickness or 3.125 mm × 450 years = 1,400 years to breach.
cst	Carbon steel tank. Nominal 1,000-gal, 10-gauge wall (3.5 mm [0.1406 in.]), primed and painted with gloss enamel.	Table 5-4 Summary of release types and release rate coefficients… (Holdren et al. 2002) allows 450 to 680 years corrosion per mm of steel. Conservatively using 1/2 the thickness or 1.75 mm × 450 years = 790 years to breach.
csblm	Concrete-shielded drum, usually 55-gal in size. The drum is inside a poured concrete monolith; after filling, the lid was poured, or the access ports sealed via pipe fitter procedures. Concrete thickness is up to 2 ft.	Method of construction and closure of penetration(s) provide, based on the thickness of the penetration sidewall (pipe cap), a minimum of 1,000 years containment.

Table D-1. (continued).

Container Code	Container Description	Time-to-Breach Analysis
dwcan	A double-wall can originating from the Materials and Fuels Complex. There are two types of construction: (1) the inner can is carbon steel and the outer can is stainless steel and (2) a double stainless can. Two types of closures: (1) gasket and bolted and (2) seal welded.	Materials of construction provide a minimum of 4,500 years containment.
gi	Government issue (GI) can, usually a 30-gal garbage can, smaller containers within, bottles, poly bags, small cans, etc.	Failure sufficient to allow water transport of Tc-99 has been calculated from a radiation-based embrittlerment study, providing an exposure time to achieve 10^8 rem absorbed dose, point of failure, divided by 100 for conservatism. Due to the protective factor provided by the can, mechanical failure of the package was not considered.
ins	General term used for a waste package shipped in a cask, undefined insert.	Depending on the situation, the insert would be a paper carton or metal insert with or without an inner plastic/poly container.
liquid	Liquids shipped for disposal then drained from the transport tanker into a disposal location.	
none	No container used. Especially true in the earlier years, i.e., before 1974, for the disposal of excavated earthen material lumber, and scrap metal, etc. This practice was discontinued about the time mentioned.	No containment is assigned a “zero” period to release.
nrscr	Naval reactor scrap cask insert. Painted carbon steel without a leak-tight closure. Constructed to allow draining to a drip-dry condition when removed from the Expended Core Facility Water Pit.	Resistance to Tc-99 migration is inherent to the waste material, which is core structural in nature. Also included are fuel bundles in tact. These factors provide at least 4,500 years protection.
otc/2poly	An open-top can with a double poly bag liner, closed and sealed. Smaller packages of various materials, including poly, glass, and metal were placed within the double poly liner. Primarily originating from Reactor Technology Complex hot cell operations and occasionally from Test Area North hot cell operations.	Failure sufficient to allow water transport of Tc-99 has been calculated from a radiation-based embrittlerment study, providing an exposure time to achieve 10^8 rem absorbed dose, point of failure, divided by 100 for conservatism. Due to the protective factor provided by the can, mechanical failure of the package was not considered.

Table D-1. (continued).

Container Code	Container Description	Time-to-Breach Analysis
pc/poly	Paper carton, ice cream type with a poly bag(s) liner containing smaller packages of various materials, including poly, glass, and metal. This package originated from Materials and Fuels Complex operations.	Failure sufficient to allow water transport of Tc-99 has been calculated from a radiation-based embrittlerment study, providing an exposure time to achieve 10^8 rem absorbed dose, point of failure, divided by 100 for conservatism. Due to the cushioning provided by the paper carton, mechanical failure of the package was not considered.
poly	Primary containment is either plastic bagging or individually wrapped items, layers of plastic are undetermined. When bulk loads were transported in the earlier years, poly or canvas was used to cover the load in an attempt to prevent contaminated dust from leaving the transport vehicle, which was not a packaging. This later changed to poly-lined truck beds and wrapped loads. This type of packaging was expected to be only for transport.	Breach time sufficient to allow transport of Tc-99 is considered to be immediate upon disposal; therefore, assigned a time value of “zero.”
SHADE	A concrete-shielded hot air drum evaporator with an outer steel pipe shell, originating from Materials and Fuels Complex.	1,000 years.
vault	A concrete container either cubical or cylindrical in shape. Nominally 10.2 to 15.2-cm (4 to 6-in.) -wall thickness with rebar and painted.	Method of construction and closure of penetration(s) provide, based on the thickness of the penetration sidewall (pipe cap), a minimum of 1,000 years containment.
vp	Pressure vessel, no specifications available; however, the wall thickness is a heavy cross section.	These vessels are normally constructed of very corrosion-resistant material and have heavy cross section that will provide a minimum of 4,500 years containment.

Failure of Plastic/Polyethylene Containers

To establish the conservative failure rate for polyethylene barriers, a study performed by Matthern (2005) was utilized that calculated the failure rate based on the interaction between radiation and the polyethylene. This failure rate was calculated from the surface dose rate of the waste package. Many of the containers of concern were directly addressed in the report and the breach-time estimate documented as part of the report (Matthern 2005). Some of these values were adjusted to account for higher internal radiation levels inside the shipping container. This was accomplished by dividing the reported values by 100, which accounts for the effects of shielding on the surface readings. The new values were then used as the projected failure time. When the container of concern was not in the report, the surface dose rate of the waste was indexed to an equivalent surface dose in the report and the associated failure date similarly established.

Container-failure Statistical Distributions

Not all of the container types listed in Table D-1 contained Tc-99 or I-129. Each applicable container type was mapped to one of five failure distributions, as shown in Table D-2. Table D-3 briefly describes the five failure distributions. The inventory for Tc-99 and I-129 from the Waste Inventory and Location Database was then allocated to each failure distribution according the each shipment's container type.

Table D-2. Container types with technetium-99 mapped to a failure distribution.

Waste Container	Failure Distribution	Waster Container Description
bxc	Immediate	Cardboard box without a poly bag liner.
bxw	Immediate	Wooden box, usually made of exterior grade plywood, painted with fire-retardant paint and lined with poly or contained individually poly-wrapped items, nailed and glued lid and banded.
none	Immediate	No container used. Especially in the earlier years, i.e., before 1974, for the disposal of excavated earthen material, lumber, and scrap metal, etc. This practice was discontinued about the time mentioned.
blm	Early	Metal drum/barrel of various sizes, usually with some type of liner. Wall thickness is uncontrolled.
can	Early	Similar to a paint can, with a plastic liner and usually dry loaded.
cask	Late	Normally, a steel shell with lead shielding and a payload cavity, reusable in nature. When so noted, the cask was disposed of.
cst	Late	Carbon steel tank. Nominal 1,000-gal, 10-gauge wall, primed and painted with gloss enamel.
dwcan	Late	A double-wall can originating from Materials and Fuels Complex. There are two types of construction: (1) the inner can is carbon steel and the outer can is stainless steel and (2) a double stainless can. Two types of closures (1) gasket and bolted and (2) seal welded.
Radioactive Waste Storage Facility liner	Late	Radioactive Waste Storage Facility liner from Materials and Fuels Complex. Consists of an 0.5-m (18-in.) carbon-steel pipe with a welded bottom closure and a bolted top closure.

Table D-2. (continued).

Waste Container	Failure Distribution	Waster Container Description
bal	Wide	Compacted waste bale. Waste was first placed in a poly bag, then compacted into a cardboard box, which was then poly wrapped.
bxc/poly	Wide	Cardboard box with a poly bag liner or individually bagged or wrapped items.
otc/2poly	Wide	An open -top can with a double poly bag liner, closed and sealed. Primarily originating from hot cell operations.
pc/poly	Wide	Paper carton, ice cream type with a poly bag(s) liner.
poly	Wide	Individually bagged or wrapped waste items.
durapoly	None	Any poly-type container (bal, bxc/poly, otc/2poly, pc/poly, or poly) that has a failure time >1,000 years.
vault	None	A concrete container either cubical or cylindrical in shape. Nominally 10.2 to 15.2-m (4 to 6-in.) -wall thickness with rebar and painted.

Table D-3. Failure distribution definitions.

Failure Distribution	Distribution Description and Parameters
Immediate failure (I)	No container or insubstantial container. Container failure and release commencement is immediate.
Early failure (E)	Thin-walled carbon-steel container, e.g., 55-gal drum, government issue (GI) can, etc. Container failure and release commencement in 0 to 500 years.
Late failure (L)	Stainless-steel container or thick-walled carbon-steel container. Container failure and release commencement in 500 to 1,000 years.
Wide failure (W)	Primary or secondary container is poly. Container failure and release commencement in 0 to 10,000 years. (Highly dependent on radiation field.)
No failure (N)	Encased in thick-walled concrete. Container will not fail, and there will be no release within 1,000 years.